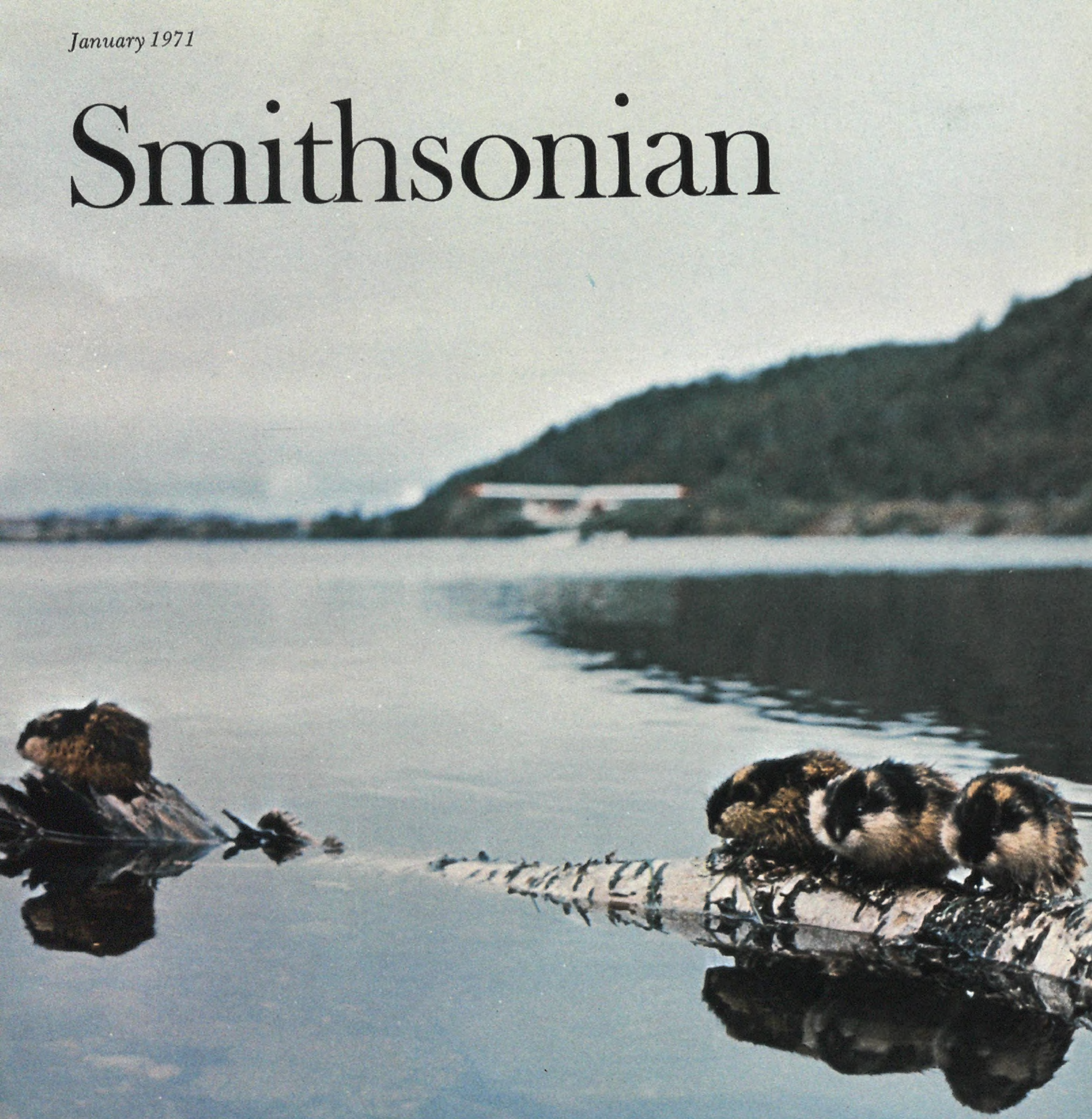
January 1971

Smithsonian



The mysterious lemmings: Norwegian migrants cling to a birch log in their mass journey to death (p. 6)

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The view from the castle

After 62 years the Radiation Biology Laboratory has moved out of the cellars and into the light, but for how long?

"On a clear day you can see forever," as the song goes –but not in Washington. Years ago, in 1907 to be exact, you apparently could. At that time the midpoint of the Mall was a small eminence, a rise in the ground called Smithsonian Park, where the air was presumably clear. It was only to the west, beyond the Washington Monument where the Mall sloped off into the Potomac, that river fogs often obscured vision. That is why the State Department has had to resign itself to the sobriquet of "Foggy Bottom," for it overlooks the former marshes that gave rise to the appellation.

A nearly unrequited love of the Smithsonian for all these years has been the measurement of solar radiation. Partly funded at one time by grants from the Research Corporation in New York, this activity has generated some of the most fundamental laboratory research in biochemistry and photochemistry being carried on in the United States.

I say "nearly unrequited" because for many years the scientists laboring in what we now call the Radiation Biology Laboratory were confined to the cramped cellars of the Smithsonian "castle," where they worked under nearly intolerable conditions in areas meant for storage only. Many of their measuring instruments were installed at the top of the castle's tallest tower.

As I mentioned in the May issue of this magazine, a series of measurements was commenced in 1907 and completed in 1969—measurements which indicated that between these dates the amount of direct sunlight reaching the center of the Capital has decreased by about 14 to 16 percent. This decrease appears throughout the visible range of the spectrum of solar radiation, although the ultraviolet area fluctuates more than others. Even though they are still being assessed, these measurements were the first conclusive demonstration of the fact that various substances produce smog even in otherwise clean cities, and that this puts a damper on our daily life.

Other Laboratory "firsts" have occurred in pioneering research on the photosynthesis of plants, on photocontrol of seed germination involving significant food plants, on the induction or reversal of light-influenced growth in plants and on the movements of growing plants toward sources of light. Ramifications of this research spread into the very fibers of present-day environmental studies. Similarly, the Laboratory's carbon-dating facilities have been involved with studies of recent historical climatic changes, which are of primary concern to archaeologists. No laboratory is an island, and the Radiation Biology Laboratory's activities are closely tied to our kindred scientists' work in biology, ecology and anthropology.

Last year the Radiation Biology Laboratory moved to cleaner, more spacious quarters in Rockville, Maryland. From the roof of the new laboratory, where the instruments are now measuring solar radiation, the director, Dr. William Klein, and I recently looked out across the landscape with the feeling that on a clear day we *could* see forever. Only to the southeast, lower down, was there a yellowish-gray haze where Washington lay beneath a veil. The whole Capital has become a foggy bottom. How long will it be clear in Rockville?

S. Dillon Ripley

Why the great whales are being slaughtered... and what you can do to help save them

Whales are being slaughtered to the point of extinction for pet food (and for motor oil, paint, margarine, soap, suntan oil, hand cream, lipstick, and so on). Yet there is not one single product of the whale for which there is not a more readily available substitute.

Whales are being wiped out by commercial whalers at a rate that will make the whales effectively extinct in less than a decade—a rate that will consequently ensure the extinction of commercial whaling too!

If this incredible display of mindless greed offends you . . . and if you would like to actually do something, personally, to help right one of man's transgressions against nature . . . you should welcome this opportunity to join The Whale Campaign, a nonprofit program of the New York Zoological Society that has been organized to put whales under effective, world-wide protection.

Your membership fee of $9.95 enrolls you in The Whale Campaign and brings you a copy of the extraordinary new 12-inch stereo recording, "The Songs of the Humpback Whale," and a 40-page book. The majority of the profits from the sale goes to the Whale Fund.

A Triumph for 20th-Century Technology

If you think whaling folded when kerosene lamps were invented, you just haven't kept up with the industry's progress. In fact, man has become almost as efficient at killing whales as he has at killing men!

Thanks to innovations such as cannon-fired harpoons, today's electronically outfitted whaling ships average between one and two kills per day. Back in Ahab's time, the average was closer to one a month. In the decade of the '60s, the whaling industry racked up an all-time record. At present rates the industry has less than ten years left before there aren't enough whales to make whaling profitable.

Act Now . . . or Forget About Whales

The Whale Campaign is a crash program to convince users of whale products to accept alternatives—to reach the business powers, interest groups, and statesmen who, acting together, can enforce world-wide protection for whales — to finance continued research into the little-known nature of whales.

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Letters to the Editor

Damage to Cleopatra's Needle

Dear Sir: How does the condition of the obelisk on the Thames in London compare to that of Cleopatra's Needle in New York [SMITHSONIAN, November]?
W. P. Bebbington
Aiken, South Carolina

See below. Ed.

Dear Sir: Starting from the same mint condition as the New York Needle, London's version has hardly eroded at all. It is clearly legible on all sides to anyone who knows how to read hieroglyphics. In fact as recently as 1967 the London authorities gave it a cleanup to remove what soot had collected on it from London's coal-tainted air. A spokesman for the Greater London Council now remarks that it "is looking better than it has for several centuries."

One explanation might be that, placed along the Thames embankment as it is, London's Needle gets shelter from the winds. Another might be that the oily pollution from modern fuels has not had as long a chance to work on ours as on yours. If this is true it may be that the London Needle will also succumb to dirty air, after surviving a bomb which damaged its plinth in the first world war.
Mrs. Anne Angus
London

Dear Sir: Apropos the article in SMITHSONIAN on the Central Park obelisk, I have been speaking out about its damage for about 20 years, believing we should return it to Egypt where it belongs or protect it within a building, preferably the former. World travel is becoming so much easier that more interested people will see it in Egypt than in New York.
Thomas Dixon, M.D.
Thomaston, Maine

Oil spills

Dear Sir: In Warren Young's article on oil spills [SMITHSONIAN, November] the term absorption is used in regard to oil and straw. Should not the word adsorption have been used? Adsorption refers to capillary attraction while absorption is a soaking up like a sponge.
R. P. Alexander
Redondo Beach, California

Dr. Thomas Murphy of the Federal Water Quality Administration believes both terms are correct but to avoid confusion most marine experts use "sorption." Ed.

Dear Sir: The recent article on the oil spill problem was timely and exceptionally well done as was the photography. The picture on page 26, however, shows a woman washing oil from a bird. The caption says the bird is a grebe when actually it is one of the species of cormorants. The body size and shape and the shape of the bill are characteristic.
Ralph Fisher
Silver City, New Mexico

Mr. Fisher is correct. Ed.

Dear Sir: The caption under the picture, "Droplet of crude oil" that appeared in the article on the oil spill problem is misleading. Bacteria cannot handle such large amounts of oil because they are overcome and soon die.
Michael D. Margolis
New Rochelle, New York

Mr. Young's article pointed out that, despite its theoretical feasibility, doubts have been raised about whether bacteria can destroy marine sediments that lack oxygen. Where oil has sunk to the bottom, it may remain indefinitely. Ed.

Portland's plaza

Dear Sir: Wolf Von Eckardt's article on Lawrence Halprin's beautiful plaza [SMITHSONIAN, November] made me feel free as a bird and so happy that we still have beauty in the midst of urban areas. I quote from a letter addressed to Franklin Delano Roosevelt jr: "I have read of discussions about a suitable memorial for your father and I think something like this would be appropriate. It is an amazing grouping of water containers and falls —with movement, joy, freedom, warmth and beautiful architecture."
Edna O. Hokenson
Bethesda, Maryland

Radio astronomy

Dear Sir: To Dale F. Dickinson's excellent article on radio astronomy, just one note of comment: Sir William Herschel was never "Astronomer Royal at Greenwich." Rather he was the (personal) Royal Astronomer to King George III, subject only to the stipulation that the Royal family reserved the right of viewing the celestial bodies by means of his instruments upon request.
C. B. Eaton jr.
Department of Mathematics and Astronomy
Pasadena City College
Pasadena, California

Mr. Eaton is correct. Nevil Maskelyne, not Herschel, was "Astronomer Royal" at the observatory at Greenwich. Ed.

Dear Sir: Your article on Radio Astronomy states that the Milky Way (as well as the Andromeda Galaxy) has a spiral structure. The author later says: "Technological earthman is only a couple of hundred years old, a newcomer in a galaxy that may be ten billion years old."

I read some months ago a science article stating that since the galaxies are billions of years old, the difference in orbit times of stars in galaxies should long ago have wiped out any spiral structure.

It seems to me that this one fact of spiral structure must mean that the age of the galaxies must surely be only a fraction of the ten-billion figure that your article gives.
Everett H. Peterson
San Jose, California

According to Dickinson, the author, Mr. Peterson has touched on a sore point in the galactic structure business. This little paradox shows that the spiral arms are not easily explained by simple stellar orbits or motions of the gas in the galactic plain. What they are is the subject of rather esoteric theoretical inquiry, per-

haps density waves propagated through the interstellar medium. The point, at present, is not settled. We do know from other sources, however, that the Milky Way Galaxy is many billion years old. Ed.

Dear Sir: As I understand the radio astronomy article, the gas and dust comprising the interstellar medium are acted upon by densities, temperatures and collision rates to form the molecules in space. If this statement is true, then what is the composition of the gas and dust, and, even more important, where does it come from?

I recall an astronomy class I attended in which the same puzzle was presented regarding the presence of gas and dust in space. Upon asking its source, I was ignored by the professor and subjected to the smug, raised eyebrows of my peers.

J. Lee Robinson III
Zirconia, North Carolina

Author Dickinson's answer: The primary source of gas was probably the primordial hydrogen cloud from which the galaxy condensed. Heavier elements were subsequently formed by nucleosynthesis in stars and ejected into the interstellar medium by such means as supernova explosions. The source of the primordial hydrogen? The question leads to metaphysics where Mr. Robinson's answer is as good as mine. Ed.

Dear Sir: I was somewhat chagrined to realize I had credited those involved in the recent detection of interstellar molecules in my article, but failed to note the discoverers of the hydroxylion—the people who started it all back in 1963. They are Drs. Sandy Weinreb, Alan Barrett, M.L. Meeks and J.C. Henry.

Dale F. Dickinson
Smithsonian Astrophysical Observatory
Cambridge, Massachusetts

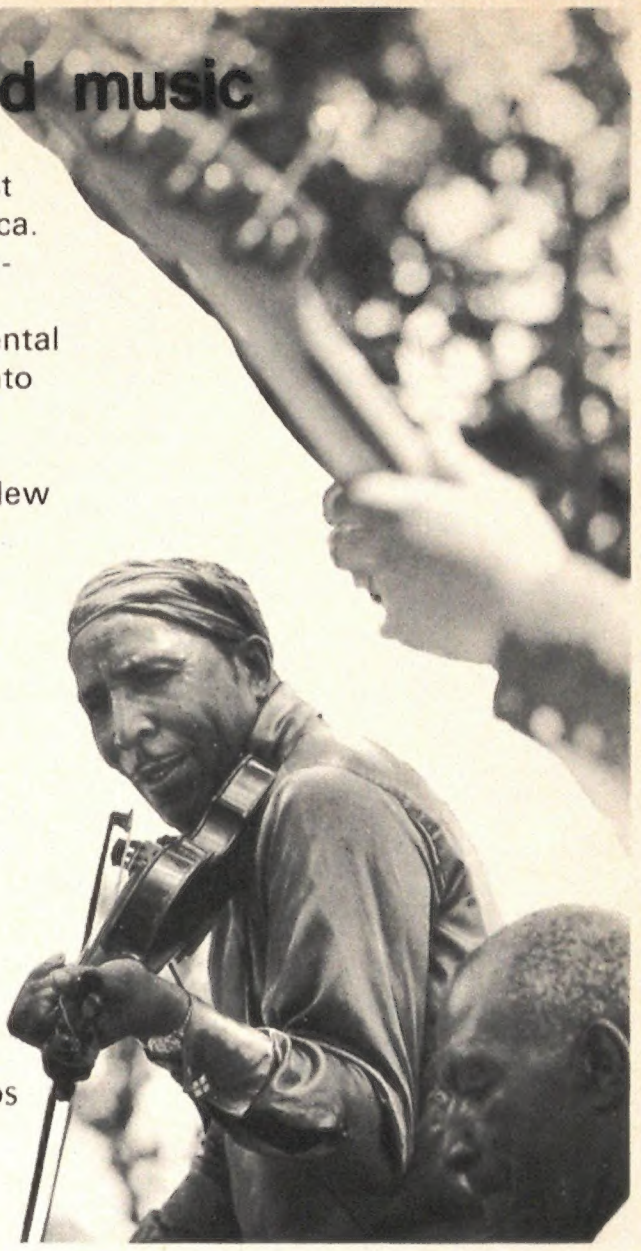
Contemporary art

Dear Sir: I don't like Op or other forms of modern art, including the British contemporary art you featured in your November issue. I believe that modern art began as a revolt against Art Nouveau. Art Nouveau demands true drawing ability. I say, back to Art Nouveau.

Phoebe Perkins
Aston, Pennsylvania

See page 58. Ed.

down homeland music



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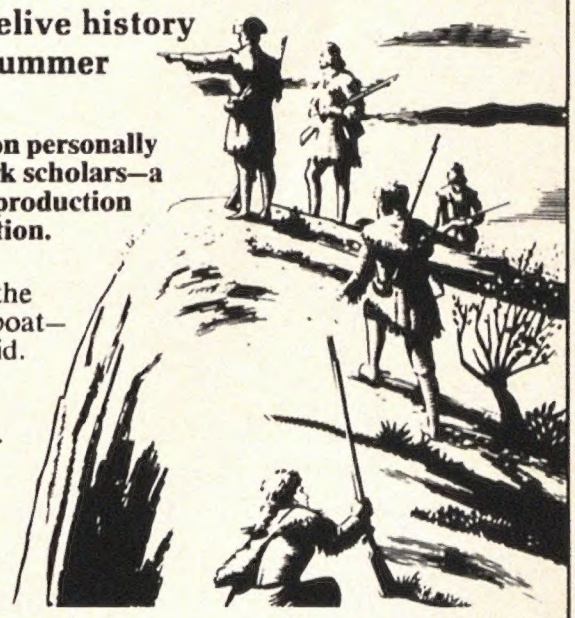

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By John B. Calhoun

The lemmings' periodic journeys are not unique

In the current self-destruction cycle of the Norwegian rodents a behavior authority finds other mammals, maybe Man, similar

I have never seen a lemming. At least I have never seen one of those biological entities called *Lemmus lemmus*, the "true" or Norwegian lemming, found in countless numbers throughout the world's northern latitudes. Nor have I ever seen any of the other species of lemmings that inhabit these circumpolar regions. I feel about the little mammals the way humorist Gelett Burgess felt about his purple cow: "I'd rather see than be one."

Perhaps because I have never seen one I can actually see them better. I can define for myself the phrase "lemming phenomenon," when thousands if not hundreds of thousands of these rodents march to the sea, plunge in and swim out until, exhausted, they drown. Swept back on the beach, their bleached bones form windrows on the shore.

Norway stands out as the country where the lemming death marches occur most frequently. Every three to four years these migrations take place in one or more places in Norway, as in these pictures taken in the late fall of 1970. Sometimes the migrations are moderate in size and only come to the attention of some isolated village or an inquiring biologist. At other times vast hordes of true lemmings (*Lemmus lemmus*) may invade many towns and even reach Oslo, far from the closest breeding grounds.

Over most of the world the tundra habitat of lemmings covers the lowlands between the zone of permanent ice and snow and the tree line. In Scandinavia, the tundra forms a tongue of lichen, moss, grass, heather, willow and dwarf birch extending far southward down the mountain range. Normally, the rodents avoid permanent rocky, snowy areas above the tundra and birch and coniferous forests below it. Between these regions, the low-lying tundra vegetation offers food and protection for the shy, mostly nocturnal creatures. They build their maze of trails, and each year the females rear two or more broods of young. Those born in the spring may themselves bear litters in the summer; those born in the summer start their contributions to the population in autumn. Thus, even though an average animal may live little more than a year, this overlapping of breeding generations

Lemming photographs by Bjørn Reese, Mice photograph by Yoichi Okamoto

Research psychologist at National Institute of Mental Health, Dr. Calhoun was subject of a SMITHSONIAN *article in April. His artificial "mouse worlds," deliberately overcrowded, focus attention on Man's population explosion.*

Reaching the water's edge, lemmings
mill about reluctantly, then dive in. They
can swim a mile across calm water,
but tackling the ocean is too much for them.

permits the lemming population to increase rapidly.

Increase it does. Long before the lemmings begin to overtax their food supplies a general state of unrest develops. More and more of the animals forsake their normal sedentary way of life, wandering about aimlessly, upsetting still sedentary associates. When too many young lemmings avoid the depredations of foxes, hawks and owls and survive to adulthood, increased contacts among them lead to anxiety, strife and an unsettled way of life.

In years of abnormal population increase the degree of wandering reaches such a scale that more and more individuals begin pushing out of their normal tundra home. Some few move up over the inhospitable snowfields. More move down into the adjoining birch forests at lower elevations.

During times of approaching population peaks the great majority of those who move downward into the birch forests never return to their homeland. Many die where they have overwintered. They are particularly stressed; many bear scar tissue from wounds inflicted earlier by their more dominant associates.

As spring approaches, a new wave of emigrants takes the road down the mountain. This even larger mass consists of young born during the fall and the long winter of breeding under the snow cover. These young are physically healthy and fat, and their departure seems motivated by the general unease: They seek to alleviate this by moving into less desirable habitats.

Each lemming sets its own course irrespective of its fellows. Gradually, the animals lose their nocturnal ways. They amble across openings, one after another, at irregular intervals, seeming not to care about predators. When they meet each other they merely bark or scuffle briefly before each goes his own way.

Soon this second major wave begins to encounter the remnants of the earlier one in the birch forest. This contact sends the first migrants farther down the

Townsfolk of Kirkenes, on Norway's Arctic coast, sweep dead lemmings from their streets. The migrating animals die in droves—perhaps because of overactive adrenalin glands.

mountain into the coniferous forest zone. Each wave of lemmings forms a broad, ill-defined band several miles in depth. Here local concentrations often build up as the migrants pause to eat at forest clearings where food is more plentiful. Finally, the numbers in these pockets increase until fresh unease drives them on down the mountain.

Each onward moving group adds impetus to the groups below. They too renew their downward course. Channeled by the narrowing valleys, these loose groups gradually coalesce, and the growing masses approach the cultivated land at the bottom of the valley.

By this time some remarkable changes in behavior stand out. Earlier in their travels lemmings skirt sizable bodies of water. But by the time they reach the lowlands their reluctance to enter ponds and small lakes is tempered. Each lemming creeps down to the water, pulls back and waits a few minutes while more and more gather behind. They make several approaches and withdrawals. Finally, each seems overcome by some compulsion to resume its onward movement following the same direction of the valley.

The animals plunge in, irregularly, with little evidence of a coordinated signal to proceed. Buoyed by fat and fur, they splash along and most eventually reach the opposite shore of still lakes which may be as much as several hundred yards across.

Gradually, the rodents lose nearly all reluctance to enter strange situations. By the time they have reached the seaside villages, waves of them are further compacted. They still move more at night than day, so it often happens that villagers awaken to find yards and streets swarming with them. Due to the irregularity of the migrations in any particular valley, as much as 18 years may have elapsed since lemmings have been seen.

"Where did they come from?" people ask. Certainly not from the surrounding pastures where none were seen the day before, when the cows were brought in. Certainly not from the surrounding woodland, where wood choppers had been.

"From the skies! Yes, they must have come from the skies. God caused them to be rained down from above as a curse on the village." Such was the myth that took form by the 15th century and still tempted the minds of many into the 20th. Cats and dogs were encouraged to kill the alien pests. Boys with brooms joined the fray. "Shovel them up! Get rid of them! Let's have no reminders of our iniquities!"

Through and around villages the lemmings proceed to the sea. Then, with diminished hesitancy, they plunge in, one by one. They swim ever outward along the trajectory dictated by their long journey. Like a random polka-dot fabric spread over the sea the swimming bodies (can we still call them lemmings?) extend

Lemmings set out to swim across a lake.
They tend to follow the direction of
the valley they have left, but wavelets disorient
them and often capsize and drown them.

for thousands of yards by the time the last enters the water. Ever farther outward they persist, perhaps a million or more. Finally, even the strongest can paddle no more. None survives this final plunge to return homeward. Quiet returns to the shores. Only the mat of bones remains as a bleak reminder of the lemming phenomenon.

To the present day, students of the lemming migrations paraphrase Charles Elton's query of 30 years ago: "How [could] evolution by natural selection have maintained the migratory stimulus when all those that respond to it perish, and all that do not are survivors?" As long as that query confronts scientists, we are little better off than the promulgators of the "falling-from-the-sky" myth of five centuries ago.

So what is a lemming? Is it an animal or an idea?

Over most of the northern hemisphere—and where there are few valleys descending from the uplands—lemmings rarely migrate at the peak of their population increase. They may wander outward, diffusely, for relatively short distances. Most die from a kind of "shock disease," an overtaxing of the adrenal-pituitary system which normally enables them to cope with unexpected stresses. Even in Norway, many lemming population peaks are *not* followed by mass migration to the sea.

What is a lemming? Is it more than one of the many lemming species, even that particular *Lemmus lemmus* that inhabits Norway?

Since 1750, hundreds of records tell of the common North American gray squirrel making mass migrations similar to those of Norwegian lemmings. Out of the hills of western Connecticut squirrels moved west and down the valleys until they encountered the Hudson River. They plunged in and many drowned before reaching the opposite side. Many even took to the Bear Mountain Bridge, or hitched rides on ferryboats. Similar migrations have come out of the Ohio hills following river valleys to the Ohio River where many also died attempting to swim across. The Mississippi River also has been the Waterloo of other migrating hordes of gray squirrels.

What is a lemming? Can it be any kind of mammal which engages in a mass movement in a fixed direction with such obsession that it readily enters all environments it would normally avoid?

Several years ago I was reminded of lemming migrations while involved in some studies of small mammal populations. We were finding that the entire community of mice and shrews living in a forest were woven into an intricate fabric of social relations. In this fabric, certain dominant red-backed mice maintained the largest ranges, overlapping each other to form a chain-mail-like pattern across the forest. We have learned

In the stress of migrating, lemmings submit to handling
by Norwegian admirers. Unlike hamsters, they are hard to tame.

that ranges become smaller down the social scale, with much less overlap between one individual's range and that of the nearest neighbor of its own kind. In fact, at the bottom of the scale, usually abundant long-tailed shrews maintain such small ranges that they are rarely trapped during the normal short-term census trapping.

However, after 25 to 30 days of trapping, a different picture emerges. The dominant animals with large ranges are trapped most easily and are thus mostly removed within a few days. They can no longer inhibit other species. Members of subordinate species then enlarge *their* ranges and are themselves trapped. Finally, a whole piece of this social cloth within and just adjacent to the trapping plot is cut out. Few former residents remain.

This phenomenon of interdependencies within small mammal communities generated an idea of inducing a lemming-like mass movement. Several hundred traps were set in a 30-acre plot. They removed nearly all of the residents within 30 days and so created a social void. The layer of animal "fabric" adjacent to the void then moved in and in turn was trapped. This initiated a chain reaction that ripped apart the entire social organization.

As each strip of animals moved toward the void, their neighbors occupied their vacated homeland, moving in as if to escape from social pressures of others still farther out. The migrations ceased shortly after trapping in the central area ended. But it was clear that social disruptions, other than those which occur in Norway, can produce a directional movement.

What is a lemming?

Can a "lemming" be defined as any animal which can be induced to emigrate in large numbers from the homelands of its birth? That was an idea I clung to until two months ago. I really should know better than to put such stock in each new notion. That's the way of science; you hold fast to each new formulation as if it were ultimate truth, and yet down deep you know that at best it's a leaking boat. This time I've sunk myself by launching an even sturdier boat of ideas.

Overcrowded mouse worlds give clues

Perhaps you have heard of my "horrible mousery," my "paradise" for house mice (SMITHSONIAN, April 1970). It really is a mouse utopia; it provides for all their physical needs. But unlike the lemming ranges of Norway, the walls around this utopia allowed no escape when the mouse population began to exceed tolerable limits.

This habitat contains 16 apartment units. Each apartment contains 16 rooms. As it turned out, the mice decided how many could live comfortably in each apartment. They set the limit at ten, for they really don't like crowding. Thus, 160 adult mice filled up all the "social space." Before the population had increased to this number from the initial eight colonizers, those who were old enough to breed produced more than 400 even younger mice. When these matured they had no place to escape to physically—and there was no place to go socially except for a very few who managed to replace some of their aging brethren in the social structure.

Their reaction was to withdraw psychologically, to huddle in motionless masses in the less-used space on the floor. True, these mice were extremely stressed, but mostly from the bursts of violent attacks that they directed at each other. The dominant mice paid little attention to them. When the younger mice's violence subsided, they become hollow shells, not participating in any social life with the favored few.

Mice too stressed for mating

Still the socially settled few kept breeding, just as the lemmings do in that last fall and winter before their major march to the sea. In this last frenzy of reproduction 1,600 more mice were spewed out into this closed environment. A replica of "spaceship Earth?" They too found no social "rooms" in which to mature. As each member of this horde grew physically it began to express its natural behavior, trying to take part in sex and other acts of social intercourse that are necessary for survival of the species. But rarely was a mouse able to complete this action before it was interrupted by some associate.

Only the simplest behaviors, such as eating and drinking, were ever carried to completion. The mice never really learned to mate or fight. Never fighting, never competing for mates, never protecting young, they never knew stress. Most matured into passive blobs of protoplasm, physically healthy but socially sterile.

Despite physical maturity these beautiful mice remain as juveniles, frozen in a childlike trance. As young mice they are curious about strange objects and strange situations. The biggest strange object they encounter is me. I can go into the large central space of the habitat and walk slowly about in circles. Rapidly, a mass of several hundred of these beautiful mice gather about my feet and trail along as I move.

Earlier in the history of the population, when young mice were maturing normally, they would sometimes approach my feet, then accept them as an irrelevant aspect of their environment and pay no attention to them. But these poor beautiful mice never learn; each day they follow human feet about as if they had never seen them before. The youngest of these mice are over eight months old, or 25 years as human span is meas-

Lemmings on the march

ured, yet they behave like novice 30-day-old mice, recently weaned. Is the story of the Pied Piper so mysterious after all?

What is a lemming?

Perhaps these beautiful mice are more "lemming" than lemmings. They live in a world of abundant food. Lack of food doesn't make a lemming. They live in a world precluding migration. Failure to migrate doesn't make a lemming. They are all still happily living—physically, that is. Destroying one's life doesn't make a lemming.

Yet these are denizens of a "horrible mousery." And above all, they are voiceless. They are deathly quiet. Lost are the plaintive squeaks of recognition, the higher squeaks of inquisitive anxiety, the shrill squeaks accompanying more intense social involvement. A pallor of silence hangs over the flaccid following mass.

I am coming to believe that they are truer lemmings than those Norwegian ones who follow the long downhill route to the sea.

Lemmings are lemmings. Squirrels are lemmings. Mice are lemmings. Are there lemmings in our metropolitan tundras—silent shadows of the selves they might have been, ready to follow in unquestioning masses any flickering figment on a glassy screen? Are they ready to bring civilization to suicide?

Mass suicide, the phrase applied to lemmings, has haunted man for centuries. We need not quibble about the strict applicability of the word suicide in this context. Undoubtedly, the lemmings have no consciousness of their impending doom when they plunge into the sea. But suicide, particularly mass suicide,has a far broader meaning. It is a joint death participated in by many when the customary way of life of a species is threatened. For the Norwegian lemming faced with overpopulation, the exodus and death of many provide an opportunity for rejuvenescence by remnant groups. Their hereditary way of life can be renewed as their tundra environment recovers from its former overuse. With every mass death, then, there *may* be a rebirth.

Man's way of life differs from that of all other animals. Periodically he has been faced with crises, not of numbers, but of ideas. Old ways became outmoded, new ones emerged. We have always had the choice of which would survive, which would be allowed to "commit suicide." Sometimes the new ways drew the lot of suicide and areas of the world were left to stagnate and die. Sometimes areas adopted new ways that enlarged human potential.

Let us go back to my mice "lemmings," the beautiful ones. For more than a generation now they have failed to reproduce their kind. No young mice have appeared, and all present evidence suggests that they will age and die without progeny. They are "overliving." They might as well have died at birth. The population seems doomed. They have already committed suicide.

We, if we are to be called human, produce ideas as well as ourselves. Whenever we fail to produce new ideas and utilize them we commit suicide.

Our crisis of ideas

Right now we stand at the first dual crisis in our history, a crisis of both ideas and numbers. Previously our letting outworn ideas die, and new ones live, enabled more and more people to populate the earth. This epoch of evolution is nearing an end. We face an entirely new crisis: How can the potentiality of the average individual continue to expand as it has in the past when he no longer has the option of linking more and more people into a communication network to generate and spread ideas? That is the real question facing the world today.

In this country the time is no more than five years away until we will know if we are going to face this question of a rebirth of ideas. That time is 1976—our nation's bicentennial. Then we will either "overhallow" the past and so dedicate ourselves to the suicide of overliving, *or* we will open up a new era of evolution marked by increased creativity, awareness and compassion.

What is a lemming?

Author plays Pied Piper to his overcrowded
and hence socially deprived mice. They have never
learned normal adult ways so they follow
his feet with the thoughtless curiosity of babies.

Photographed normally, a California reservoir appears as it would to the eye of a pilot.

By Paul A. Dickson

Sensitive, remote eyes show changes on Mother Earth

Techniques like color-infrared photography tell Man more about his planet and the fruits and problems thereon

For three weeks last August and September four airplanes crisscrossed the state of Indiana. Flying at altitudes from 3,000 to 60,000 feet, they photographed the flat Indiana landscape from north to south to determine whether the southern leaf blight, the fungus infection that claimed a large portion of the nation's 1970 corn crop, could be spotted from high altitudes. Last April an RB-57F aircraft on loan to NASA for the Geological Survey of the Department of the Interior began flying over American cities at altitudes greater than 50,000 feet. By late 1970 26 cities in 16 states, the District of Columbia and Puerto Rico had been photographed by the nine cameras in the plane to determine the extent to which urban change can be monitored from the air and space.

The Indiana flight showed that the blight can indeed be identified from the air (see p. 16) and indications are that it may be perceptible in its earliest stages,

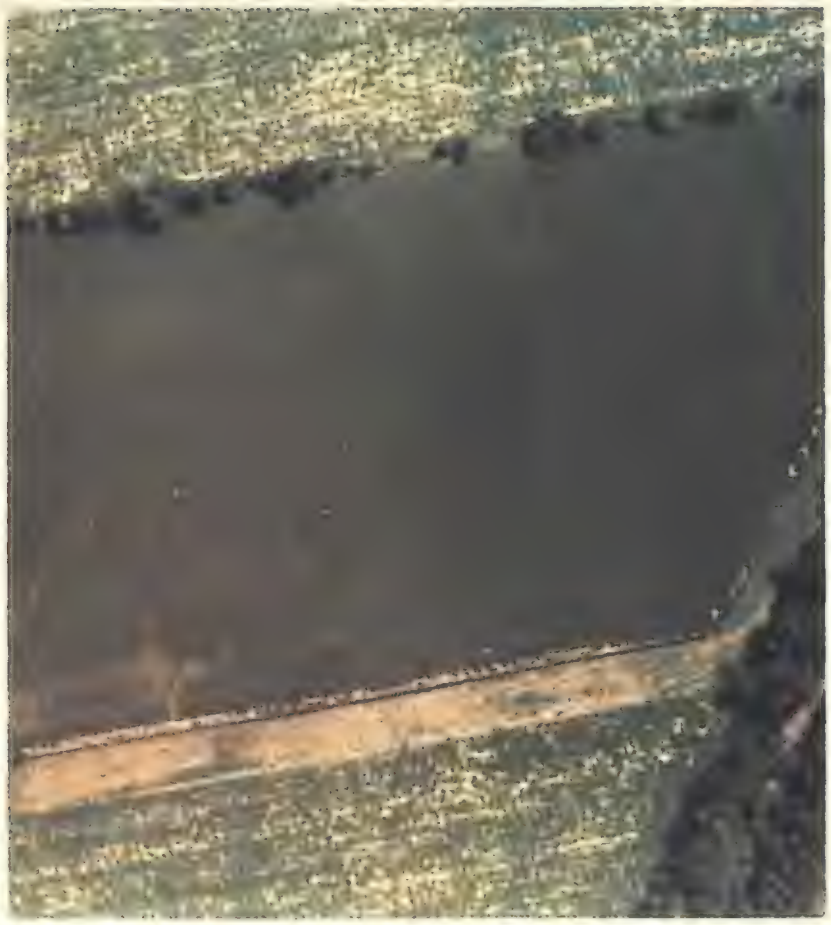
With color-infrared photography, species of plants—and their diseases—can be sought.

permitting early identification and warning of the blight as well as providing a means of accurately surveying the damage. Officials at the Geological Survey feel that urban flights of the second program will provide an important new product: a comprehensive inventory of urban data reflecting such information as extent of pollution, use to which land is put, amount of vegetation and condition of neighborhoods. They believe that repeated coverage of urban areas will serve to give urban planners a much better idea of what is actually going on in cities and provide them with a cheaper, more efficient and speedier alternative than the presently common method of "windshield" inspections, in which officials and planners try to determine local change by driving around.

Hundreds of similar missions with diverse purposes have been conducted in the last five years by universities and government agencies. The technique is called remote sensing, and it is both the basis for exploration of the earth by airplane and the precursor of the earth resources satellite program. The first such satellite is scheduled to be launched in March 1972. Though relatively inexpensive as space ventures go, the program may have the greatest earthly impact of any space effort to date. For starters, it may lead to a more cordial and respectful relationship between man and his environment. Currently at least a half dozen federal agencies, scores of universities and a number of private firms and research institutes are preparing for the first satellite.

Although remote sensing might seem too remote

Paul A. Dickson, a Washington-based free-lance writer, has covered such diverse subjects as highways, the Basques and Ralph Nader. His book on think tanks will soon be published.



Spectral color photographs showed the 1970 corn blight (brown) attacking fields in Indiana.

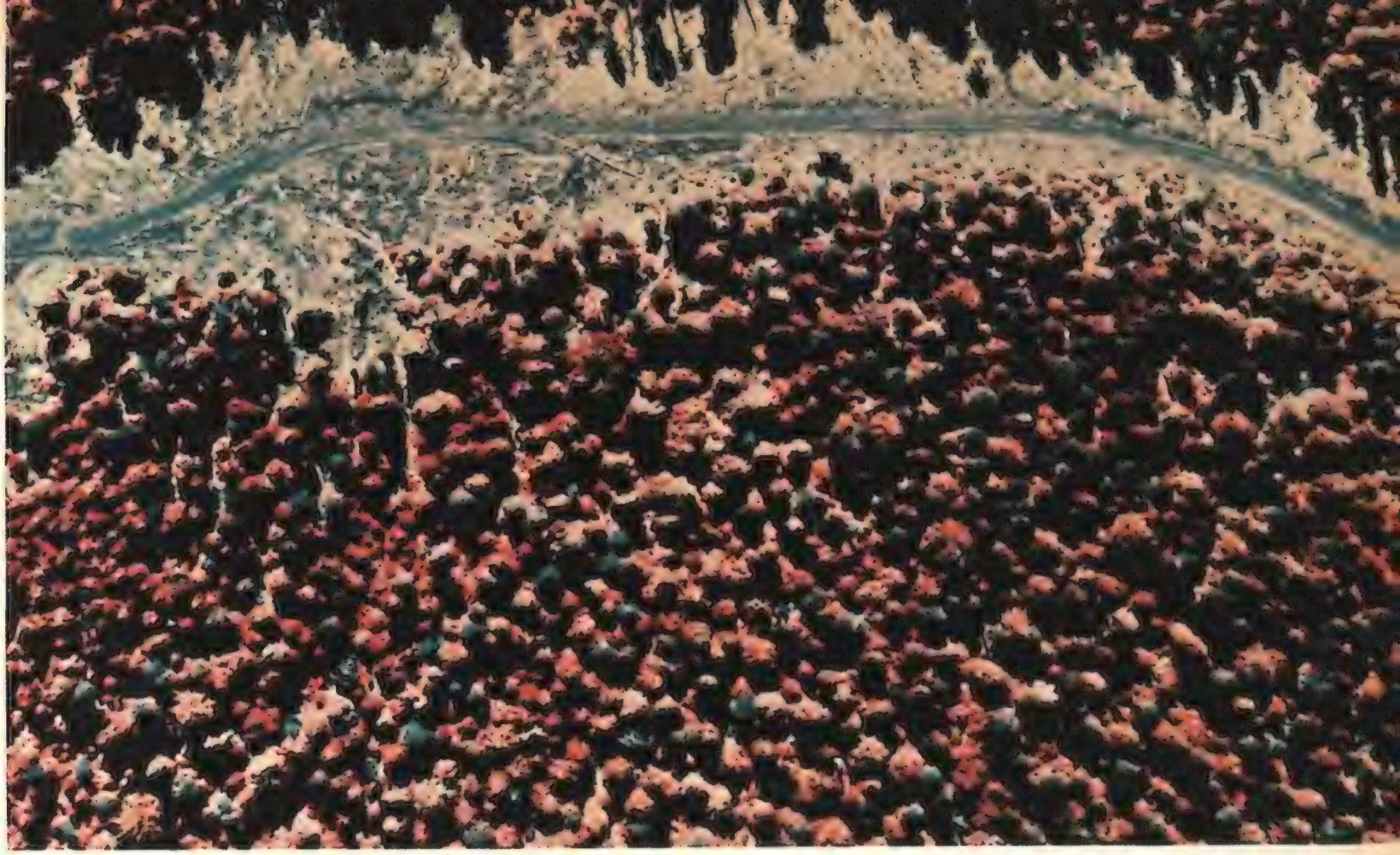
when done from orbit, space offers a superb vista for looking and learning about the earth. Not only have photographs from aircraft proved highly successful, but pictures taken by Gemini and Apollo astronauts in earth orbit have provided dramatic and often unexpected findings. Gemini 4 photographs taken in 1965 revealed hitherto unnoticed clues to sources of oil and gas in North Africa. Photographs taken by the crew of Gemini 5 over Tucson, Arizona, helped the Geological Survey create a road map combining the best properties of the conventional road map and a detailed photograph. Gemini 5 and 7 pictures of Cape Kennedy revealed the embarrassing fact that even the most current maps of that area did not show many of the roads and man-made objects.

Apollo 9 carried four cameras which took simultaneous pictures of the earth. Three of them made exposures in green, red and near-infrared bands of the light spectrum; one took color-infrared pictures using all of it. Infrared is radiation at wavelengths longer than the eye can see. Among other things, it transmits the radiant heat from a stove or radiator. Photographed in the reflection of this radiation, growing plants stand out vividly white among nonliving things because they readily reflect the infrared. Moreover, because it is less scattered, it passes more readily than visible light through haze and smoke, permitting the viewer to see better through these obstructions.

Color-infrared photography is a process whereby information in visible and infrared radiations is combined and printed in one photograph, permitting more precise analysis in certain situations. For example, yellowing vegetation and healthy green vegetation might show up the same on infrared, but visible wavelengths would indicate the difference.

Use of the different cameras on Apollo 9 was a test of some of the techniques that will be used in the first earth-resources satellite. Perhaps the most dramatic Apollo 9 photograph shows a distinct line right where the Texas-New Mexico border appears on political maps (see p. 18). The line was produced by a difference in appearance between the two states and stands in direct contradiction to the long-held belief that a political boundary was an imaginary line. Further investigation revealed that different irrigation policies practiced by the two states had created a line. Still other Apollo 9 pictures clearly show the Mexican-American border; it is visible because of both the difference in water use and the preponderance of different crops on either side of it.

Although manned spacecraft in orbit provide good platforms for resource data collection, unmanned craft are less costly and offer long-duration coverage of the earth. Future manned missions will collect resource information, but the main thrust of the national effort for this purpose is toward unmanned satellites. A second satellite will go into orbit about a year after the first launch, at the time when planners anticipate that the first one will begin failing. Meanwhile work will probably be starting on a series of "operational"—as opposed to the first two "experimental"—earth satellites that will be refined workhorse models patterned after the experimental ones. The estimate made by Theodore A. George, NASA's program manager for the earth-resources satellite program, is that the first



In color infrared, trees infested with insects stand out blue against healthy neighbors.

operational satellite could be built and orbiting as early as 1974.

After the first satellite is launched in 1972, it will go to an altitude of 492 nautical miles and then into a longitudinal course that will take it near the north and south poles on each orbit. Every 18 days it will have covered all of the United States. Since the orbit selected is a sun-synchronous one, it will insure that the sun angle over any scene on the ground will be the same each time the satellite passes overhead. On the ground three receiving stations—at Corpus Christi, Texas; Fairbanks, Alaska; and Greenbelt, Maryland—will be getting data transmitted from the spacecraft. At least one site is within communication range of the satellite whenever it is over the United States or adjoining ocean areas.

The eyes of the satellite will be three specially built television cameras and a multispectral scanner. The scanner views the scene with four channels. Three of them will record the light in three different portions of the visible color spectrum and the fourth in the near infrared. The second satellite will have a fifth channel in the thermal infrared region.

The three TV cameras will take pictures simultaneously of 100-by-100 nautical-mile sections of the earth in different portions of the spectrum—one in green, one in red and the third in the near infrared.

Because the scanner will record its information digitally (a set of numbers telling the intensity of light of the particular wavelength from each spot in the scan) its views will be uniquely suited for computer analysis. Television and scanner camera images are intended for both visual interpretation and automatic data-processing methods.

These sensing devices working together will produce images that will be transmitted to the ground where some will be looked at singly while others will be combined. Manipulation of these images will permit identification of very specific information not apparent to the naked eye. For example, virtually every type of object under the sun has what is called a light signature. Just as snow, corn, a pine tree, a volcano and a geologic fault show different colors, so do young barley, mature barley and diseased barley have different light signatures. Slicing up the spectrum makes identification of these signatures easier. Diseased trees, for example, are made to show up blue in infrared photographs while their healthy counterparts appear bright red (see above). Looking at objects in different lights also permits deeper probing. It is easier to see through clear water in the green portion of the spectrum, and surface water shows itself best in the near infrared.

To establish what researchers call the "ground truth" of remote sensing, NASA has selected four sites in the United States where high altitude photographic

The border between New Mexico (left) and Texas reflects different land-use policies.

images can be verified by actual identification on the ground. In one site, the Chesapeake Bay study site, the Smithsonian Institution's Ecology Program is correlating the ground identification of plants with infrared, color and black-and-white photographs being taken by NASA from helicopters and aircraft.

Other equipment will make the earth-resources satellite an orbiting agency for picking up messages signaled from the earth's surface. "Scattered around the country," says George, "we will have up to a thousand sensing devices each of which will measure some bit of information such as air temperature, precipitation, water levels, soil moisture, solar radiation, wind velocity and snow depth. A radio transmitter associated with each sensor will send the information to the satellite as it passes overhead. The satellite will forward it to one of our ground stations."

The purposes of this part of the experiment are threefold: First, it will attempt to show how information from measuring devices located in remote unattended areas—such as a sensor recording snowfall high in the Rockies—can be quickly relayed to a central location; secondly, it will give quantitative information that will coincide with the TV and scanner images, thereby helping to interpret them and verify what they tell us; and, finally, it will help in the calibration of the cameras.

Many government agencies will be rigging sensors for the satellite. The Department of the Interior, for example, is currently working on quite a few, including a series that will be located on volcanoes throughout Central America and the western United States. These sensors will provide data for the ongoing research program of the Geological Survey. Its goal is reliable prediction of volcanic eruptions. A precursor to the set of volcano sensors—and to all earth-resource sensors—is now forwarding readings from the top of Mt. Rainier, a slumbering volcano in Washington, to a passing Nimbus meteorological satellite. Whereas the initial number of sensors will be up to a thousand, the estimated number equipped to work with operational earth-resources satellites could soon grow to ten times that number.

William A. Fischer of the U.S. Geological Survey is the man in charge of the program to process, investigate and distribute the information when it starts showering down from satellites. Fischer says, "We will be getting it out to as many people as we can as quickly as we can." Individuals such as farmers, fishermen, sportsmen, ranchers, prospectors, students and conservationists will probably find the most direct benefits with a large segment of the public benefiting ultimately in such terms as early warnings on natural disasters and better land-use policies. Fischer is excited about citizens finding uses for the data. He would like local and educational TV stations to carry these lessons just before launch of the first satellite.

Specialists will reap immediate benefits.The satellites will have a vibrationless, undistorted, straight-down perspective of the earth—the photographic images will be instant maps that can be constantly updated because of the repetitive coverage afforded by the satellites. Envisioned by the Geological Survey are land-use maps, charts of geologic hazards, photo maps

"Red" cotton grows poorly in patches of highly saline, "green" soil near Weslaco, Texas.

of large sections of the United States, water-resource maps and urban maps for city planners.

Large-scale geographic features best seen from afar will give the geologist a whole new perspective; for example, faults, fractures and other gross characteristics become easily apparent from a distance, and these characteristics, when properly comprehended, often provide clues to new mineral and oil deposits. Repetitive images of the earth may also enable prediction of some volcano eruptions and earthquakes by detecting anomalies and changes in the earth's crust.

As a specific application for the hydrologist, Fischer cites the Bonneville hydroelectric dam in the state of Washington where millions of gallons of valuable water are allowed to run off annually to prevent flooding. At this dam, as well as at many others, those responsible for flood prevention must assume the "worst case possible," which is that the spring thaw will bring down a maximum amount of water. Because there is no accurate means of determining how much snow there is or how fast it is melting, these flood controllers must cautiously make room for the maximum. By knowing exactly how much water is coming down from the mountains, the spill-off can be much more tightly managed. Fischer says there are three variables that must be known to enable this kind of management: distribution of the snow, water content of the snow and the condition of the ground under the snow. Research into determining these variables from satellite data is moving quickly. The condition of the ground is the only one that so far escapes analysis by this technique, but study is proceeding. Says Fischer, "We think we can make this kind of information a reality in the future, and when the first satellite goes up, hydrologists will be able to find out at least how much snow there is and how fast its edges are receding. These observations will give them a lot more information than they have now." One study indicated that the use of remote sensing could result in several million dollars in benefits annually in the northwestern United States alone.

In oceanography, future applications include mapping offshore shoals, determining the amount of polar ice, keeping track of icebergs and large ice floes and finding clear routes for Arctic navigation. Infrared imagery is particularly suited to picking up oil spills and oil leaks on the water and monitoring their dispersion. One of the most important practical applications may well be to commercial fishing. The Bureau of Commercial Fisheries of the Interior Department is investigating the location of fish by detection of thin films of fish oil on the water's surface and recognition of currents that attract fish. Robert E. Stevenson, formerly a research oceanographer with the Bureau, analyzed the distribution of currents in the Gulf of Mexico from Gemini and Apollo photographs. Charting the currents that affect the movement of shrimp permitted accurate forecasts of shrimp population, and, with this kind of analysis, it will be possible to direct fishermen to the best areas of recently discovered shrimp grounds such as those along the northwest coast of India.

Balancing the earth's checkbook

Uses in agriculture and forestry extend beyond the highly beneficial ability to distinguish healthy crops and stands of trees from the diseased and pest-ridden. Identifying certain crops makes it possible to predict agricultural yields. One research effort now in progress is aimed at determining whether satellite sensors can detect the signature of growing marijuana. Results from manned flights suggest that satellites can detect forest fires in isolated areas, and map soils for the selection of the best location for certain crops.

One of the first agricultural users may be the nation's largest landholder, the government itself. "For example," says Fischer, "when the Bureau of Indian Affairs must make a decision whether to permit cattle to graze on certain Indian lands and when they have to decide how many cattle can be on it in future years, these data will be invaluable. Right now officials don't

have all the information they need to make an intelligent decision. When we have the ability to map these areas for density and vigor of vegetation, they will be able to make better initial decisions and keep track of those lands to see if they're getting better or worse."

Images from space may also help monitor the sources and patterns of air pollution, and may help transportation planners find more effective and economical routes. Summing up what he believes the total impact of the program will be, Fischer says, "I think the situation today is comparable to that of a rich person who keeps writing checks never knowing what his balance is. Earth-resource satellites and other innovations will tell us how much is left in the bank, and then it will be our responsibility to decide whether we want to splurge with it or spend it carefully so there is plenty left for our children."

George points to a dilemma that might offset some of the useful applications: "This is a personal opinion, but I worry that we may learn too much from this program. If we can find resources too quickly and too easily we create the problem of using them too quickly. There is a hazard implicit in being able to locate marine life accurately if that ability is not backed up with intelligent policies on how, when and with what controls fish will be harvested."

Though the first satellites are primarily intended to serve the United States, they also have international implications since they will be flying over other nations. Others might look upon them as an attempt to spy or they might construe them as means by which American interests could prospect for valuable deposits in their countries. In 1969, President Nixon notified the United Nations of America's intention to develop earth-resource data for the whole world. He said that as the program got rolling the United States would make specific proposals for international cooperation in it. An international workshop on earth resources is being planned for next spring at Ann Arbor, Michigan, and all 127 nations in the United Nations are being invited. The Canadian government has announced its intention of equipping a ground station to receive information from the satellites, and Fischer reports that he has been contacted by officials from more than 30 nations that are interested in getting earth-resource data. Last June, NASA circulated an invitation offering other nations the chance to participate in resource experiments and to date 23 countries have indicated they will submit experiment proposals. George predicts that the list will grow considerably.

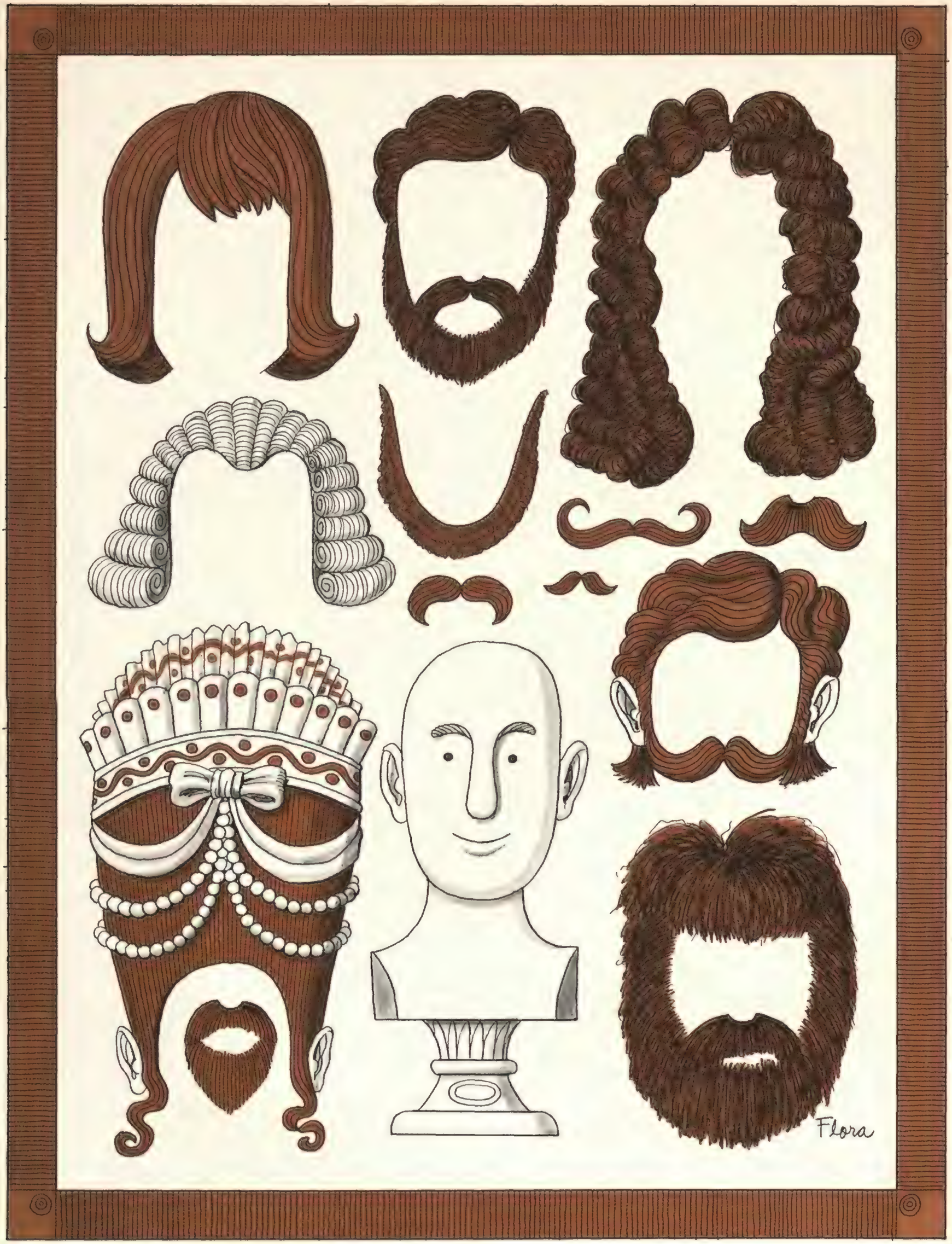
In addition to George's fear of finding too much too soon, an earth-resource program promises other new dilemmas. Not crucial but nonetheless intriguing are the changes it may force in certain institutions. One often cited example is the trading of futures in certain natural products. What impact will reliable crop forecasts have on these speculations?

A prestigious plum

Another question that must be answered is who will run the earth-resource program once it swings into full operation? NASA policy dictates that once an application program proves itself experimentally, it must be turned over to others. Meteorological and communications satellites have been acquired, respectively, by the Environmental Science Services Administration of the Commerce Department and by the Communications Satellite Corporation. Just as NASA still sends up experimental weather and communications satellites, it will undoubtedly continue to work with experimental resource satellites, but it will have to turn over the first models to somebody else in the mid-1970s. The departments of Interior, Agriculture and Commerce all have their eyes on what promises to be a prestigious and important operational program. Another option is being considered: creation of a separate independent agency for handling and disseminating earth-resource data.

There is no telling what answers will ultimately come from satellites looking down at the earth, but one's imagination is probably as good a guide as any. Will we learn more about the origins of the earth? Will we finally be able to put the Atlantis myth to rest, or will new evidence enliven that ancient debate? Will this technique prevent deaths by volcanic eruptions? Will it bring about true environmental reform? At the very least the first successful earth-resource satellite will immediately begin remedying one of the true ironies of the space age, which, as expressed by Fischer, is that, "Right now our collection of photographs of the moon are more uniformly comprehensive than those we have of the earth."

To establish the "ground truth" of remote sensing data, Smithsonian ecologists are confirming the identification of marsh grasses and other plants (various shades of red) in Chesapeake Bay.



We have always scoffed cruelly at the hairless scalp
and enveloped it in teased and tonsured growth
or, failing that, in imaginative false ornamentation.

By K.C. Tessendorf

Hair–a label we have worn from cave to commune

Pompadour, peroxide or Piccadilly weeper,
we'll try any style to 'be ourselves.'
Here's the long and the short of it all

Hair has always been a hang-up. Early scratchings on cave surfaces depict hunters sporting carefully shaped beards, their heads shaved to emphasize a tufted forelock. Our hirsute preoccupation persists in the annals of social history.

The reason is as plain as the hair on your face. Hair has high visibility and is easy to manage. Who of us can modify or improve our various weak chins, bony Adam's apples, jug-handle ears, knobby knees or feet shod in 13E? But our hair can be long or short, combed or matted, lank or curled, dyed or powdered and easily counterfeited. It serves all purposes for all men; at once badge, shield, romantic invitation. Our hair is the most facile advertisement for ourselves—after our smiles.

Baldness, some believe, is caused by a cueball hardheadedness. Thus women escape through being comparatively softheaded, or fatheaded with better nourished hair roots. The most outrageous view, recorded in pre-Lib days, posited that men inadvertently burned out the roots of their hair through heavy use of brainpower; in other words, grass doesn't grow on a busy street.

The physical dimensions of hair have been precisely measured, and the very hairs of our head have been numbered. A German accomplished this tedious task:

Washington writer K.C. Tessendorf is remembered for his story on the early days of balloons that appeared in last September's SMITHSONIAN.

on a blond, 140,400 hairs; a brown, 109,440; a black, 102,962; a redhead, 88,740. Hair is curly in proportion to its flatbladedness. It is mildly elastic. What may hang by a hair? Approximately two pounds.

The empirical resources of science once determined the clinical preciseness of Pope Julius's remark that his beard was "a forest grown populous with troublesome little animals." The experiment took place in Paris in *fin de siècle* times. A young lady agreed, solely in the interest of science, to be kissed by two strange gentlemen—one clean-shaven, the other moustached. Following a normal business day in the city, the gentlemen repaired to the laboratory, where:

"The shaven young man applied his lips to hers in the customary manner. The professor then passed a sterilized brush over the young lady's lips, dipped it into a test tube containing a sterile solution of agar-agar and quickly sealed the top. The girl's lips, and face even, having been . . . sterilized a second time, the bearded man followed the example of his shaven companion and the sterilized brush and the test tube were again called into play in the same manner. During each of the operations the young woman held her breath in order that no accidental germ might be drawn upon her lips from the atmosphere.

"After four days the tubes were opened. The first, taken from the shaven man, was speckled with dots, each of which was a colony of yeast germs, such as cause mould but are practically harmless. The second, from the moustached man, literally swarmed with malignant microbes. The long, thin tubercle bacillus was the first found, followed by diphtheria and putrefactive germs, minute bits of food, a hair from a spider's leg and goodness knows what all—so great a variety in any case that nobody had the hardihood to reveal the results of the experiment to the lady."

One symbol of maleness

Hirsute appearance was long associated with the wellsprings of virility. On the island of Delos in ancient times, boys and girls in an apparent puberty rite anointed favored tombs with "first full fruits of beard," and virgin lock. A pogonophile of that day declaimed: "The beard is nature's symbol of the male just as is the crest of the cock and the mane of the lion." Undue cutting of this heritage was for "womanish creatures."

An abundant growth of hair on women, especially on the upper lip, has traditionally been the tip-off of robust sexual resources. On the other hand, St. Modeste was revered for having escaped an untoward marriage by awakening on her wedding day miraculously decked out in a full beard. Throughout the Age of Faith pious women concealed their locks beneath chaste if elaborate headdresses.

The medieval English clergy was particularly vociferous on hair. St. Wulfstan, Bishop of Worcester, continually carried a small knife in his pocket, and whenever anybody offending in this respect knelt before him to receive his blessing, he would whip it out slyly and cut off a handful, and then, throwing it in his face, tell him to cut off all the rest, or he would go to hell. We are told a weeping Henry I had his long beard scissored by a chaplain, following a sulfurous sermon upon St. Paul's text.

Facial hair escaped this severe dictum. Pope Julius II grew a mighty beard to enhance the majesty of his appearance. Certainly the stereotype of the wise, bearded patriarch endures. Could Michelangelo have been convincing in the Sistine chapel had his Jehovah been as hairless as his Adam? Can we relate to a shorn Santa Claus, Uncle Sam (originally beardless) or Christ in a crewcut?

Hair has a familiar role in differentiating the stranger from our own kind, visibly setting off master from slave, youth from age. Greeks generally favored natural growth, but Romans settled upon short hair and shaven cheeks. For some centuries in France, the Establishment was bearded, the peasantry shaven. When the latter gradually became as hairy as their lords short hair returned to high fashion.

Styles occasionally had whimsical origins. When a king too young to support a beard ascended the throne his courtiers had to shed theirs. The reign of Francis I was shorthaired because he wished to display a head wound valorously received.

When fashion had banished the beard from the rest of Europe, Peter the Great sought to westernize the Russian masses by decreeing them beardless (peasants excepted). There was great consternation; those who were able began to flee Russia. Peter ameliorated the decree by imposing a stiff tax on beards. Some of the devout, too poor to pay, reluctantly cut theirs to be piously preserved and reunited with their owners in the grave. They feared to stand beardless at heaven's portal before an outraged St. Peter.

The rare blond of the classical era in the eastern Mediterranean was considered the scum of the earth, until light-haired northern barbarians began to score military successes against the Roman Empire. Thereafter, blond and red-haired barbarian women were sheared as regularly and profitably as sheep, to provide wigs for fashionable ladies who could not afford to shade their raven braids with gold dust.

Queen Bess owned 80 wigs

By 1550 women's hair had emerged publicly from outdated headdresses, and within a few decades cosmetics appeared on the European scene. Hair was frizzed, powdered pale violet, false curls and ringlets crafted, the whole mass held in place by sticky pastes. Bogged down in goo, women soon shaved it all away, and resorted to periwigs of great variety and splendor.

Queen Elizabeth, a natural blond, preferred an auburn tint in her wig—she owned about 80. These were often festooned with jewels, flowers and feathers. Sometimes when raw material was in short supply unwary children were grabbed and sheared.

Natural hair was back in by the mid-17th century, fashioned over wire nets, sometimes peaking like a rooster's comb, sometimes "wired-out" into curls with strands of pearls. Romance was served by small curls at the nape of the neck called *crève-coeurs* (heartbreakers); others hung near the ear, *confidants.*

Wigs were popular again toward the end of the 18th century. A great emancipation occurred about 1830 when hair began to be styled to fit individual person-

ality instead of merely the rigid dictates of fashion.

Powdered wigs, as we know from early American presidential portraiture, were as popular among men as among ladies. A concession to amour was the 17th-century lovelock, a much longer braid of strands hanging in front of the left shoulder.

Men possessed one fashionable advantage; they could experiment endlessly with their whiskers. Beards at various times were braided, twined with ribbons, ornamented with precious stones, powdered with gold dust, colored "a vivid green, a fine orange, and a deep rich blue." The fantail beard was "three inches long in the shape of a fan, rounded and set off with two long stiff whiskers, catlike in appearance. At night the fan-beard had a wadded bag to sleep in, and for the good reason that the scented wax with which the beard was colored and stiffened took some time to manipulate, and was easily cracked."

The moustache had its finest hour in the late 19th century when it curled, drooped, bristled and pointed like waxen daggers. There were moustache strainers and moustache trainers. Sideburns had outlandish designs: muttonchops and "Piccadilly weepers"—full-blown swathes hanging at the ears and framing a smooth-shaven face like dusty side curtains.

Long a mark of protest

It is an easy step to convert hair fashion into a banner of protest. Subjugated by short-haired, smooth-visaged Normans, the original Britons bristled ferociously to signify their discontent. The "roundheads" of Cromwell were in visible reaction against the mannered tresses of Charles I. An era of elegant wigs was literally cut short in the French Revolution. Dissidents of our day, polarizing upon the point that cropped crowns and hairless cheeks are unalterably the badge of puritanical meanness,have forgotten this style was initiated by libertine souls, among them Oscar Wilde, in revulsion against the shaggy insufferability of late Victorians.

Richard Corson in his excellent compendium *Fashions in Hair* recalls that 17th-century Harvard boys were forbidden "long haire, locks, foretops, curlings, crispings, partings, or powdering of ye haire."

An American lady writing at the beginning of this century got exercised over the implications of whiskers: "There are opinionated whiskers . . . long and narrow. They announce as plainly as possible 'I am it. All else is dirt.' I never saw a man wearing a Van Dyke beard who was not selfish, sinister, and pompous as a peacock....There are unctuous whiskers—long, broad, sweeping, plethoric. . . . They usually fringe full, sensual, smug, hypocritical lips. Never trust such whiskers. . . . There are the whiskers of the anarchist—unkempt, matted, a ferocious setting for a savage face."

Do shaggy, shoulder-length locks inform us of contemptuously rebellious nihilists or dangerous revolutionaries? In relative numbers there are a very few who relate their thorough revulsion against society by their unkempt appearance. Vast publicity, and a natural, kindred distaste for authority, have stirred the current of imitative fashion. Yet the mod gentleman who supports a habit of $20 to $50 a month at his hairdresser is scarcely seen as a surly anarchist.

Hair costuming—wigs and paste-on sideburns, beards, moustaches—has suddenly come on as a business of promise. Short-haired musicians don shaggy wigs to perform at rock concerts, and hirsute youths remove lovebeads and produce crewcut wigs at National Guard armories.

For just a few dollars, you can now change your whole personality.

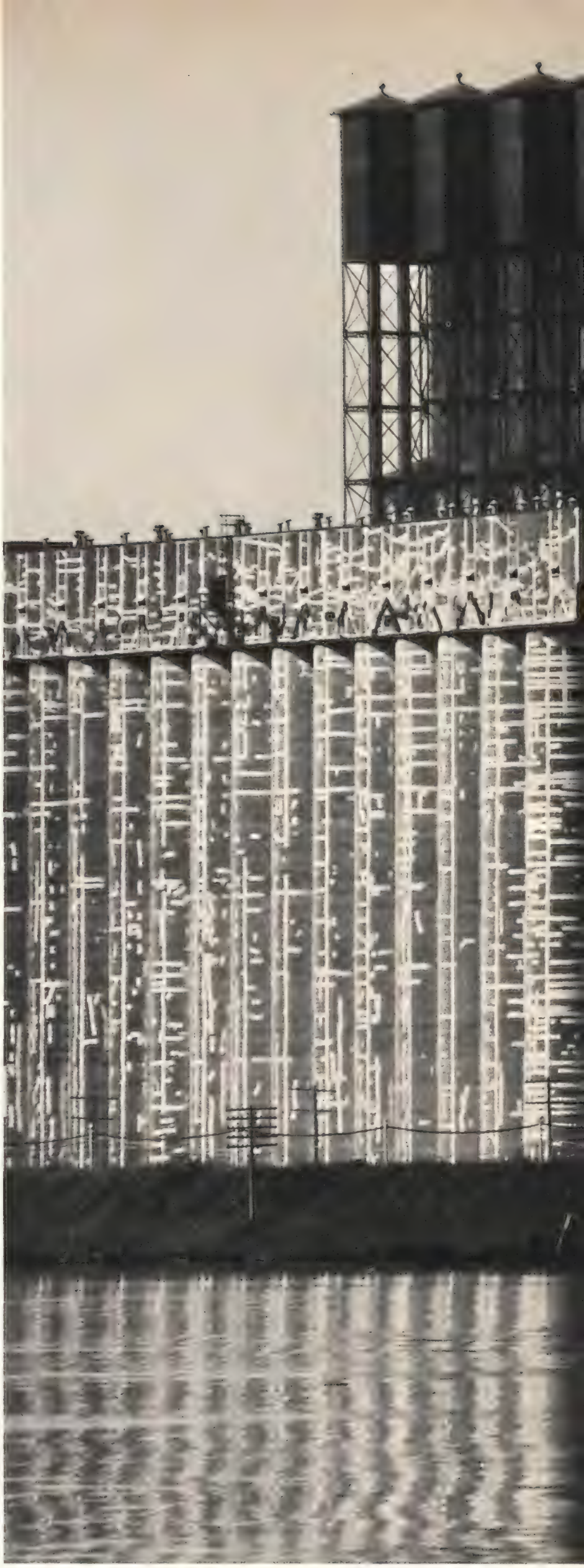
Photographs and text
by David Plowden

The hand of man on America

A photographer documents the frequently wonderful, but also increasingly appalling, things that we have done to our land

These photographs reflect my grave concern over what is happening to America today. Originally I photographed because I felt love and admiration for what I saw and I wanted to document some of our magnificent creations, such as our heroic machines and the great though often anonymous examples of our building art, many of which are disappearing. As I photographed, however, almost imperceptibly I became aware that in focusing on past achievements alone I was not portraying the America which in fact we now are living in. I felt an urgent necessity to photograph the country as it was being transformed and our increasingly dismal condition. For the time being, therefore, I put aside the documentation of other generations in order to record the America of my own time.

As a photographer I have turned to the way I know best to express my deep distress over our appalling indifference and our misplaced priorities. I have tried to show on the one hand what we are capable of and on the other what we are doing.



Terminal at Superior, Wisconsin, stores grain prior to transshipment by freighter. This photograph and the others are from an exhibition of Mr. Plowden's work currently on view in Washington. They are the subject of a book, *The Hand of Man on America,* to be published early this spring by the Smithsonian Institution Press, © 1971 David Plowden.

Habitat is where we live. It is the familiar, the environment with which we are surrounded every day. It is composed mainly of the commonplace: our homes, stores, places of worship, garages, movie theaters, banks, post offices, barns, the buildings which are the molds of our homesteads, neighborhoods, towns, cities, our lives. Most of us ignore our architectural surroundings because of their familiarity and because the routine of daily life occupies our attention so completely.

We often don't look around because, in our minds, the elements are not special; they haven't been pointed out to us, they are not the object of a trip, nor would many of them be considered national or historic monuments in the usual sense of the phrase. Not being concerned with it, we are not apt to see the wealth in our daily architecture. This anonymous architecture has a rich variety and includes many fine examples of American building that are as interesting as our better-known architectural monuments. Most of it is not the product of formal architectural training, but of the ingenuity of the American people whose native genius is often expressed in the individuality of their building. These structures are far more representative of American architecture than are the Mount Vernons or the reconstructed Williamsburgs.

Habitat by definition is "the area or type of environment in which an organism or biological population lies or occurs and is also the place where a person or thing is most likely to be found." This definition says nothing about the place being habitable, and often the place man finds himself in is *not*. Many of the places we are living in are actually dangerous to life itself, but they are so depressing, also, as to pose an equal threat to our spirit.

Ugliness is metastasizing everywhere—turn the corner, look along almost any paved road, or the approaches to any of our cities; *look* at the places where most of us have to live, what we live *with*, what we are forced to look *at* every day.

There is no pressing reason to do anything about our rejects; the land is full of poignant structures representing facets of our history; they are like tombstones, but they symbolize, more than anything else, human travail. If these seemingly impervious buildings are so susceptible to change, what about us? What about the fragile, perishable quality of the human spirit, so vulnerable to indifference? Is it, too, only a commodity subject to economic laws? Is it to be a castaway as well? Could it be true that we are pawns of the world we have created?

"Look along almost any paved road, or the approaches to any of our cities"—Doremus Avenue in Newark.

DINER
85

Economics dictated the undulations of the Richmond-San Rafael bridge in California. The two ship

channels necessitated high-level spans, but between them the roadway dips to save steel in the piers.

"After the pioneers came the railroads"—a freight train rolling along west of Havre, Montana.

Can Americans survive

There's one major problem with the 4-day work week—the 3-day weekend.

Too many of us throw away our leisure time, simply because we're not aware of all the things we could be doing. We spend more time than we'd like flat on our backs, watching TV, or collapsed on a hammock in the back yard.

So, if the 4-day week comes, Americans will have to look hard for a way to fill what could be a debilitating 3-day vacuum. And American industry will have a chance to satisfy an enormously expanded leisure-time market.

At Olin, we've begun to work on this in two ways. One, by educating the public to the opportunities for fulfilling non-work. Two, by providing products and services to meet leisure-time needs.

Our educational arm is Winchester® Press, one of the few presses in the world devoted exclusively to recreational (principally outdoor) activities. To complement this, Olin has an interest in Harbinger Productions, a film com-

a four-day work week?

pany which will do the same job as our press in the audio-visual field.

As to products and services—our subsidiary, the Olin Ski Company, manufactures quality skis in Switzerland and the U.S. and markets them internationally—we have a major position in the camping equipment field—we're one of the leading manufacturers of tents—we're in the midst of expanding Winchester® Adventures into a total sport and adventure travel service, which will include camera safaris, river running expeditions, skin diving, skiing and wilderness trips—and, in cooperation with Pan Am, and other organizations, we're building 10 safari lodges in East Africa.

To this can be added our century-long involvement in recreational shooting, hunting and game conservation.

In short, we're off to a good start in a burgeoning field.

So if the 4-day work week ever comes, the 3-day vacuum won't. **Olin**

Comments quoted in captions are from the article.
"... an uninterrupted stream of fantastic images of extraordinary plasticity and vividness ... accompanied by an intense, kaleidoscope-like play of colors."

By Madeleine Lundberg

Behind the scandal of LSD: it opens doors for research

This 'disreputable' drug has respectable uses in medicine and psychiatry. Here is the scientific side of the picture

In the science-fiction thrillers of the late show, scientists usually make important discoveries by accident. They overturn a flask in the laboratory, and the result is, perhaps, the destruction of a good portion of a major city by huge, unpleasant lizards.

Real-life science is not so haphazard, yet significant accidents do happen. The best-known laboratory mishap in recent times was Dr. Albert Hofmann's discovery of the mind-altering properties of lysergic acid diethylamide (LSD). The subsequent history of LSD adds all the overtones of a cinema thriller. More than 30 years after its discovery, LSD is variously considered to be either a dangerous drug that drives people crazy or a magical potion of supreme significance.

Dr. Hofmann, a Swiss pharmacologist associated with the Sandoz pharmaceutical laboratories near Basel, does not like to call his adventure with LSD an accident. After all, he and another Sandoz researcher had synthesized LSD way back in 1938. They were investigating ergot—a poisonous fungus that grows on rye; its derivatives are used in certain medicines. They had run some standard laboratory tests on LSD, had even given it to a batch of animals and, without noticing anything stupefying, had put it back on the shelf. Thus, Dr. Hofmann explains, what happened one afternoon in 1943 was not absolutely mystifying. He prefers to call it a "chance observation."

Dr. Hofmann chanced to observe in himself "a peculiar restlessness associated with a sensation of mild dizziness" and decided to take the afternoon off. When he went home to lie down, he further observed "an uninterrupted stream of fantastic images of extraordinary plasticity and vividness . . . accompanied by an intense, kaleidoscope-like play of colors." These visual phenomena faded in a couple of hours.

Dr. Hofmann was pretty sure that he had been "run over" by a chemical. He recalled having prepared a new supply of LSD that afternoon, because he intended to start investigating it again. But there was no reason to believe he could have somehow got enough of the compound into his system to produce such noticeable symptoms. Nor did his observations tally with the usual symptoms of ergot poisoning. To settle the matter, Dr. Hofmann went back to the laboratory a few days later and took 250 micrograms of LSD, which he assumed was the lowest possible dose that would have any effect. He opened his laboratory journal and began to jot down his reactions.

The last words in the journal are "marked desire to laugh." They occur only 40 minutes after the beginning of the experiment. He could not write anything more, because he was in the process of observing that LSD is one of the most active chemicals known. Two hundred-and-fifty micrograms is quite a large dose. Thirty micrograms would have been enough.

Dr. Hofmann asked someone to help him home, and on the way, he recalls, "my field of vision swayed before me and objects appeared distorted like images in a curved mirror. I had the impression of being unable to move from the spot, although my assistant told me afterwards that we had cycled at a good pace."

Ordinary sounds were transmuted into brilliant colors, faces appeared like grotesque masks. Dr. Hofmann babbled and sometimes felt he was out of his body as well as out of his mind. Yet, throughout the whole experience which stayed intense for six hours, a part of him remained lucidly observant.

Once Dr. Hofmann and his co-workers had identified LSD as the agent responsible for these strange events, there remained two questions: How does the drug work, and what, if anything, is it good for? Neither of these questions has been answered fully. Indeed, the definitive answers may never be found.

In this country, where a great deal of LSD research has been carried out since the 1940s, part of the problem in answering the basic questions about LSD is its bad publicity and ensuing government control. The effects of LSD on the brain are bewildering because the neurochemistry of the brain is bewildering in itself. The psychological effects of LSD are variable

A native of Sweden, Mrs. Lundberg has lived in Washington, D.C., for five years. She has won A.M.A.'s Medical Journalism Award and Columbia's School of Journalism award for magazine writing.

almost beyond description. The "trip" that Dr. Hofmann recorded was not typical; there is no such thing as a typical trip. Dr. Walter N. Pahnke, director of Clinical Sciences, Maryland Psychiatric Research Center (MPRC) at Spring Grove, Maryland, who has observed LSD reactions for a decade, says one can find "almost any kind of reaction from LSD."

Scientists have by now devised ways to classify the most common reactions to LSD. Dr. Pahnke, Dr. Albert A. Kurland, superintendent of the MPRC, and their co-workers at nearby Spring Grove State Hospital divide them into five categories. There is a psychotic reaction which is usually terrifying. There is a cognitive reaction with lucid thought in which "problems can be seen from a novel perspective." There is an esthetic reaction in which a person's sensory perceptions are pleasantly sharpened; colors seem more beautiful, music more meaningful, and sometimes—as in Dr. Hofmann's case—synesthesia occurs, so that sense impressions of one kind (such as sound) are translated into impressions of another kind (such as sight). There is a psychodynamic reaction in which a person may relive scenes from his childhood and may bring forth emotions and fantasies normally buried in the subconscious. Finally there is a mystical or "peak experience" reaction. During such an experience a person seems to transcend the limits of time and space toward an indescribable peace and unity.

Some scientists recognize more than these categories, some fewer. It is rare, anyhow, that an LSD reaction falls neatly into any one category. Usually it fluctuates rapidly from moment to moment. The ineffable experience that defines a mystical reaction may last only a moment, occurring among psychotic, psychodynamic or esthetic reactions.

In the first years of LSD research, scientists were not aware that the drug could produce such a multitude of responses. Researchers focused their attention on hallucinations, distortion in body-image and other psychotic reactions which their subjects reported. Many of these were patients in mental asylums. Their experiences, if not actually horrifying, were still so strange as to sound crazy.

At first, therefore, LSD was known as a psychotomimetic—meaning that it mimicked psychosis. Many scientists were excited by the notion of inducing a few hours of experimental psychosis in normal people. Some psychiatrists felt that by taking LSD themselves, they could gain a firsthand, but tolerably brief understanding of their patients' turmoil.

But there are numerous differences between psychosis and a psychotic-type LSD reaction. Hallucinations of mental patients are usually auditory, for example, whereas LSD hallucinations are mostly visual. Also, a person who takes LSD may see grotesque floating faces, but he knows that they are not real.

The psychotomimetic interpretation of LSD lent support to the hypothesis that mental illness has a biochemical origin. Says Dr. Sidney Cohen (until recently director of the Division of Addiction and Drug Abuse, National Institute of Mental Health): "LSD teaches us that an invisible amount of a chemical can change thinking, seeing and feeling. If we find the reasons for this, we'll understand the chemistry of mental functions."

A therapy room at the MPRC shows "paintings on the walls and records to be played—everything . . . carefully selected to help facilitate a 'peak experience.' "

In the "psychodynamic reaction . . . a person may relive scenes from his childhood and may bring forth emotions and fantasies normally buried in the subconscious."

Just what LSD does to the brain is still a mystery. Recent investigations have shown that very little LSD remains active in the brain after it is ingested. Most of what remains stays in the midbrain, where the center of attentiveness is located. Currently the most widely held theory is that LSD disrupts the normal functioning of serotonin, a chemical that transmits impulses between nerve cells. The brain, Dr. Cohen explains, ordinarily organizes the information it receives from the senses in a meaningful way and acts as a screen to reduce the flood of sensory input. "Under LSD," he says, "perceptions may flood in. A point on the wall can assume an importance and perceptual intensity so that it becomes a universe in itself."

Dr. Cohen points out that this is one speculative theory. Another holds that LSD acts primarily on the brain's emotional regions. "If certain parts of the midbrain are stimulated electrically, a person feels a high, a glow. LSD may stimulate these parts of the brain by interfering with the transmission between nerve cells. The perceptual changes caused by LSD would then be secondary effects of changes in emotion."

In 1950 the first scientific report appeared on the use of LSD in psychotherapy. Similar reports have abounded since, telling how patients express things they would usually evade and dredge up instructive fantasies. They remain calm enough, meanwhile, to communicate with their therapists.

In this "psycholytic" therapy, just enough LSD is given to loosen up a patient's defenses, and 50 to 70 LSD sessions are not uncommon. In the United States, psycholytic therapy was soon replaced by another kind which provided large doses of LSD in a small number of sessions. This procedure developed when psychiatrists started to treat alcoholics with LSD. A number of researchers, notably Dr. Abram Hoffer and Dr. Humphry Osmond (at the time working in Canada), noted that some alcoholics recover only after they have experienced the horrors of delirium tremens. A large dose of LSD, they reasoned, ought to produce a truly horrifying case of delirium, and an alcoholic, shaken by such an experience, might stop drinking.

Alcoholics seemed to respond well to the treatment. Oddly enough, however, many of the subjects did not experience delirium tremens during their LSD session. What they felt seemed to be deeply positive, even religious in nature. To account for such experiences, Dr. Osmond proposed that LSD be called "psychedelic" rather than psychotomimetic. Although the term psychedelic means simply mind-manifesting, psychedelic therapy now refers to the use of LSD to produce an intense positive experience.

By 1960, it was clear to most researchers that different accounts of LSD reactions did not tally at all. Some subjects behaved like psychotics, others analyzed their problems, others described mystical visions.

At Harvard, a number of researchers, including Dr. Timothy Leary, before his troubles with the law, popularized the notion that "set and setting" were responsible for conflicting reports about LSD. "Set" refers to the basic personality, beliefs, expectations and immediate mood of a subject. "Setting" refers to the circumstances under which the drug is taken—the atmosphere of the room, the attitudes and preconceptions of those administering the drug.

Unstable subjects react badly

This explanation is generally accepted now. The notion that the facts of nature are independent of an experimenter's preconceptions is one of the nobler tenets of science. Nevertheless, a researcher's expectations can influence the LSD experience of his subjects to a surprising degree. "One scientist," recalls Dr. Cohen, "got up at a meeting and said he had never seen a mystical state produced by LSD. Another said that almost everyone he gave LSD had a mystical experience." In most cases, Dr. Cohen adds, stable and mature people have a positive experience with LSD, while unstable and rigid persons have a bad time.

Although the set and setting formula proved useful,

it eventually raised more questions than could be answered. The root of the reasoning was that the mystical sensations engendered by LSD are real and respectable religious experiences. Religious philosophers who have taken LSD have reported both that it does and that it does not lead to genuine mysticism.

One of the few experiments on the question was performed in 1962 by Dr. Pahnke, then at Harvard. He based his experiment on the research of Dr. Walter T. Stace, well-known scholar of mysticism and professor emeritus of philosophy at Princeton, who maintained that all mystics—regardless of their formal religion, culture or historical epoch—experience much the same thing in their moments of rapture.

Dr. Pahnke drew up a list of nine states of mind that seemed to be at the core of mysticism, among them a sense of sacredness, a deeply felt positive mood, a transcendence of time and space. On Good Friday, Dr. Pahnke gave psilocybin, a psychedelic, to a group of seminary students assembled in a private chapel. Another group was given a placebo. Analyzing the results, Dr. Pahnke concluded that those receiving the drug had enjoyed experiences indistinguishable from traditional mysticism.

The moral question inevitably arose: If LSD was primarily a religious drug, didn't everyone have a right to it? The government replied by outlawing it. But an impressive number of young people had already become wildly enthusiastic about LSD.

Researchers were surprised. "It's such a shaking experience to take LSD," says Dr. Cohen. "I wouldn't have predicted that it would be passed on from friend to friend." Dr. Osmond (now director of the Bureau of Research in Neurology and Psychiatry of the Neuropsychiatric Institute of the State of New Jersey at Princeton) recalls having mulled over the possibilities of an LSD fad, but dismissed it because he thought the demand could not be met. The ergot fungus from which LSD was made had been grown in carefully controlled rye fields by Sandoz in Switzerland. "No one in his right mind, we thought, would seed a field of rye with ergot because it spreads and cannot be controlled," says Dr. Osmond. Someone, however, discovered that ergot can be grown in a churn, and LSD soon appeared at low prices.

In a survey of persons who had taken LSD as part of medical research programs, Dr. Cohen found that the rate of serious adverse reactions was quite low—approximately 0.08 percent. When people take black-market LSD under uncontrolled conditions, adverse reactions are more common. The press has carried frightening stories about the misuse of psychedelics.

Accounts of users who committed suicide or stepped out of windows, believing they could fly, were followed in 1967 by reports that LSD caused chromosome damage. Many scientists who had been glad to see the dangers of LSD publicized, feel that the press has misunderstood and exaggerated the chromosome controversy. Different researchers continue to come up with different results. And no one is sure what real difference it makes; many ordinary substances, including coffee and aspirin, are known to produce chromosomal aberrations.

"Young people," says Dr. Osmond, "realized that LSD was probably not much more dangerous than a lot of other substances. The great error was to publish some chromosome findings prematurely. We created a credibility gap. The chromosome scare was a lie."

Incidentally, he says, the scare seems to have been an incentive to make purer LSD for the black market. "This cannot have been what the government intended," Dr. Osmond says.

Scientists who have given the drug to a large number of people including alcoholics and dying cancer patients are still puzzled by many of its aspects, and now fear that public controversy may put an end to further research. "Administrative bodies in various hospitals and laboratories are often reluctant to authorize LSD research," says Dr. Albert A. Kurland (whose work at the Spring Grove State Hospital is one of the few clinical LSD-therapy projects currently being carried out in the United States). "They may be concerned with their image in the community. What they read in the local newspapers may convince them that LSD research is wrong."

The effects of this vehement dispute have been distressing to scientists. "The popular misuse of LSD and its emphasis by the mass media," say Dr. Pahnke, "has led to so much concern and hysteria that effective research may be destroyed for many years."

To obtain government authorization to experiment with LSD and to get supplies of the drug can be so

"My field of vision swayed before me
and objects appeared distorted like images in a
curved mirror. I had the impression
of being unable to move from the spot."

time-consuming a process today as to discourage all but the most determined applicants. According to Dr. Russell R. Monroe, professor of psychiatry at the University of Maryland, the usual waiting period is from six to nine months. However, a spokesman for NIMH says the long waiting period has been due exclusively to "lack of staff" and that in the future there will be no more than a two-months' delay. "There is no pressure at NIMH," this spokesman adds.

Even so, says Dr. Monroe, "to get LSD, you have to write a complex proposal and follow it strictly. The procedure inhibits freedom to experiment with a number of different models and follow the one that looks best. You can't change the research without asking new permission." The notoriety of LSD also makes it hard to find unprejudiced subjects for research. "Either the subject won't touch it," says Dr. Cohen, "or they produce LSD effects on placebo."

Many scientists have abandoned working with LSD. "If there were no other interesting things to do, I'd put up with the great difficulties of getting LSD," says Dr. Osmond. Others have left the LSD research because of the painful publicity or because they want to wait until the chromosome controversy is concluded. Most people who continue working with LSD are concentrating on laboratory research and investigating the neurochemical effects in animals. This has produced a good deal of quaint lore like the fact that carp rise to the surface after consuming LSD.

Among those scientists with enough tenacity to investigate human reactions to LSD, the best known are those researchers at the MPRC, headed by Dr. Kurland. For a decade now they have been using LSD as an aid to therapy. They work mostly with alcoholics, neurotics, narcotics addicts and cancer patients, specializing in large-dose therapy.

An organized LSD session

Over the years the MPRC staff has developed a formalized way of administering LSD. Before an LSD session patients receive about 20 hours of conventional psychotherapy. The session itself is conducted in specially designed rooms that look something like motel rooms, but which the patients apparently find reassuring. Paintings on the walls and records to be played—everything is carefully selected to help facilitate a "peak experience."

Having worked with some 400 patients under these circumstances, the MPRC has reported no cases of permanent psychological or physical damage due to LSD. Convinced that LSD can be used safely, the MPRC scientists are also convinced that it is not automatically a miracle drug. In their major experiments with alcoholics, for example, the patients who were given high-dose LSD therapy had improved more at a six-month followup than patients given the same therapy with a low dose. After a 12- and 18-month followup, however, not much difference remained between the two groups; both outdid other patients.

The immediate problem at the MPRC is finding ways to make the benefits of LSD therapy more permanent. One solution, says Dr. Pahnke, will be to discover who is the right kind of patient. "We know it's not going to help every kind of alcoholic," he says. "We have to find out who can benefit from it most. For some people it's a waste of time giving them LSD."

The MPRC has also given LSD to persons with painful fatal diseases like cancer. The object of this

LSD therapy, says Dr. Kurland, is to "prepare patients by making them feel their life has been significant."

Says Dr. Cohen who did some of the original research on this facet of LSD: "People who are dying in pain and with a lot of anguish have to be kept stupefied by medications. Otherwise they become immensely depressed. About 50 percent of the patients I have seen seemed more relaxed and less anxious after taking LSD. They experience that 'not being' isn't so bad."

In the long run Dr. Pahnke feels one of the main uses of LSD may be with dying patients. Of great value, he says, is the fact that such patients can relate to their families in a more loving way. LSD doesn't put anything in them that wasn't there before, but it seems to open them up. When they overcome their fear and terror of death, they can more fully live every day.

The MPRC researchers have treated 40 dying patients with LSD. The peak experience brought on by the drug did help reconcile more than half of them; this reconciliation also helped reduce their pain. A few were able to leave the hospital and remain with their families until they died.

Some MPRC researchers feel that LSD can be used, as has been advocated, for purely religious purposes. Dr. Sanford Unger, until recently chief of Psychological Research, thinks the future of LSD will be "more in a religious than in a psychiatric framework. Psychedelic agents," he points out, "have a history of religious use for thousands of years before Christ." Dr. Pahnke is interested in finding a practical use for mysticism.

If the successes and the disappointments at the MPRC seem about equally balanced, Dr. Kurland is enthusiastic about the future. "LSD," he says, "is just a forerunner. We will become much more sophisticated and able to synthesize a wide range of substances with specific effects. The therapeutic process will be shortened . . . we will have the ability to catalyze emotional states, help resolve ego alienation, paranoia, depression, and bring about states of peace and friendlier relationships to our fellow men. Creativity and sensory modalities that influence artists will be markedly enhanced to enrich our lives. . . . In the aging process we'll be able to rekindle feelings of youth and a variety of dreams that are attenuated in the bustle of daily activities."

Not everyone shares Dr. Kurland's optimism. "It sounds great," says Dr. Leo E. Hollister (medical investigator, Veterans Administration Hospital, Palo Alto, California, who began LSD research in 1958), "but it isn't true." Most drugs are just not very specific in their action, although it would be nice if they were. As it is, drugs rarely hit precisely the target they are aimed at, and usually hit a lot of other targets in the process. "We have to accept the multiple actions," Dr. Hollister concludes.

Dr. Kurland's expectations thus have certain overtones of science fiction. But in LSD research, science fiction is traditional.

". . . An invisible amount of a chemical can change thinking, seeing and feeling."

"A person seems to transcend limits of time and space toward an indescribable peace."

By Jack Hope

In Idaho's White Clouds: mines or a park—or both

'Hysterical preservationists' battle 'gouge-and-run' miners: a governor loses his job and the Congress ponders it all

Idaho's recent change of governors can, in a sense, be traced to events 100 million years ago. That may seem entirely too great a perspective for any political leader to entertain, but it is where the story of the White Cloud Peaks begins. At that time, the earth's crust began to heave and buckle upwards, a gradual process that created the Rocky Mountain system. In the White Clouds area of central Idaho, as elsewhere, low-grade mineral deposits were created in the process and were brought nearer to the surface as wind, water and ice sculpted the peaks into the White Clouds of today.

Lying about 30 miles northwest of Sun Valley, the range's 250 peaks average close to 10,000 feet in height and cover an area of 80 square miles. Snow-capped for eight months of the year, these remote peaks harbor a number of high mountain lakes, alpine meadows and clear, cold streams.

During the several thousand years of human habitation on the North American continent, man's activities have had little impact on the White Clouds. A few trappers and prospectors visited the region but, for the most part, the White Clouds' rugged terrain was passed over by the nation's westward expansion. Eventually, the area was placed under the jurisdiction of the U.S. Forest Service.

Since the turn of the century, some small-scale mining (lead and zinc) has occurred within the White Clouds region and a limited system of hiking trails has been developed. Even within recent years the region has been only lightly used; each year, no more than 400 campers and fishermen have the patience to make the long hike into the White Clouds.

But with the pressures of today nothing remains hidden and private. No place remains undiscovered. In time, all areas—even the most remote, such as Alaska's North Slope, Utah's Escalante Canyon or Idaho's White Cloud Peaks—are found, and used, and changed in order to meet some social demand.

In September of 1968, the Forest Service announced that the American Smelting and Refining Company (ASARCO), one of the world's leading producers of nonferrous metals, had staked mining claims in the

Free-lancer Jack Hope concentrates his writing on the use of the nation's natural resources, especially those through which he can hike.

A visible reminder that no place can remain undiscovered: helicopter is landing at the ASARCO camp near Castle Peak (left).

White Clouds area, and was performing exploratory molybdenum mining operations near 11,820-foot Castle Peak, the region's highest mountain. Molybdenum, a heavy, white metal that can withstand great heat (4,700 degrees F.) before melting, is found in many locations throughout the world, generally in very low concentrations.

In its natural state, molybdenum is found united with other elements, usually in the form of molybdenite, a compound of molybdenum and sulfur. Since formation of the White Clouds molybdenite deposit 50 million years ago, this material remained locked within blue-gray seams of rock, an inert compound of no significance to the turnings of the earth or to the affairs of terrestrial life. With the onset of World War I, molybdenum was first used in quantity as an alloy of steel in the production of tanks, engines and gun barrels. Later it was used in the turbines of jet planes, the gears of automobiles and in high-speed industrial machinery. The White Clouds deposit took on a new dimension, a "market value."

ASARCO explorations in 1968 and 1969 indicated the presence of a large, low-grade body of molybdenite, which at current prices is estimated to have a value of roughly a billion dollars. Pending more complete analysis, company officials said, ASARCO would construct a large open pit mine—7,000 feet long, 700 feet wide, 350 feet deep—on the shoulder of Castle Peak. An alpine lake would be removed in the process. The firm later estimated that the mine would daily yield 20,000 tons of molybdenum-bearing rock, and would continue production for 20 to 30 years before

the ore was exhausted and the mine was abandoned.

A processing plant would be built on the site. All but .2 percent of the excavated material would form a waste product; seven million tons of powdered rock per year would be piped from the plant into a one-and-three-quarter mile-long "tailings pond" in the valley formed by Little Boulder Creek. To prevent rock powder and possibly toxic ore wastes from reaching the East Fork of the Salmon River, a 400-foot high dam would be built out of the tailings across the valley.

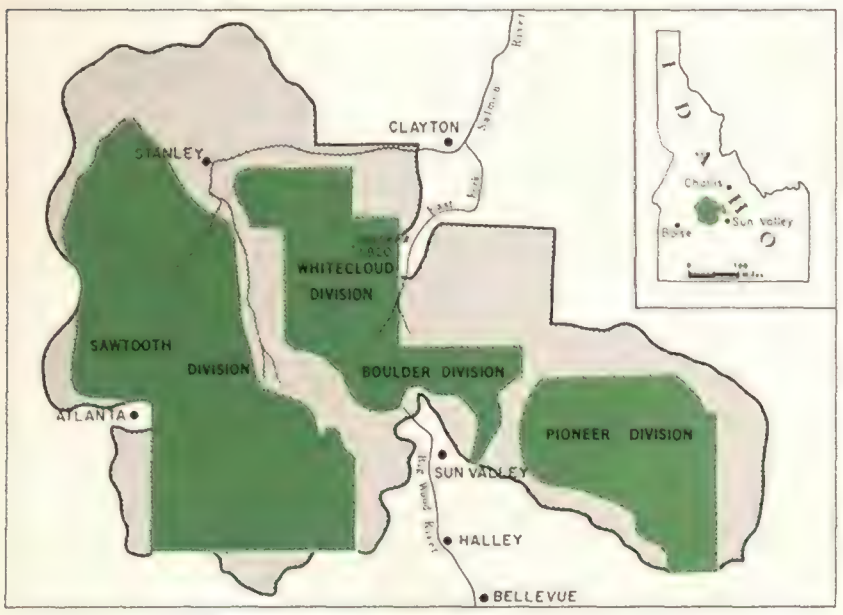
Idahoans received the news with mixed feelings. Governor Don Samuelson and several of the state's industrial leaders and elected officials spoke enthusiastically about the several hundred new jobs that would be created by the mine, and about the million dollars that would be added to the state and county's yearly tax revenue. Idaho conservationists, the state's leading newspapers and Senator Frank Church denounced the project as destructive of the scenic and ecologic integrity of the White Clouds wilderness.

One group of Idaho conservationists, the Greater Sawtooth Preservation Council, led the drive to prevent the proposed mine. In previous months, members of this group had been working on a plan to create a large national park (Idaho's first) in the vicinity of the Sawtooth Mountains, a jagged and scenic range in western Idaho that included the White Cloud Peaks.

National parks are legally and administratively exempt from uses—such as mining—that deprive an area of its natural character. On the other hand, most of the 187 million acres of public land controlled by the Forest Service is managed according to a philosophy of "multiple use." In addition to regulating the cutting of timber and protecting the vegetative cover of important watersheds, the Forest Service has to accommodate a number of other activities, including mining, skiing, camping, snowmobiling, hunting and livestock grazing. Each year the list becomes longer.

And while the term "multiple use" reassuringly implies that a given acre of land can fulfill a large number of human needs, it has become clear that many forest uses are incompatible with one another.

The mining industry enjoys exceptional privileges upon public lands except in areas such as national parks that have been legally "withdrawn" from mineral entry. The statute that still governs mining on most public land was written in 1872, long before the American public—or its lawmakers—became aware of the significance of environmental deterioration. The law thus contains no provisions designed to prohibit mining within scenic or recreational areas, to limit the amount of ecological damage caused by the mining



The Greater Sawtooth Preservation Council seeks a national park combining three "wilderness" areas with surrounding recreation zones as buffers.

Mining claims, yet to be validated, spread out northwest from Castle Peak. Underneath lies a billion dollars worth of molybdenum.

process, or to require that abandoned mine sites be restored to a condition approximating that of the natural landscape.

Critics of the 1872 mining law also contend that the century-old statute constitutes a public subsidy of the mining industry. As the law now stands, a firm may extract and sell the minerals from public lands without making any payment to the federal government other than the nominal legal fees involved. This contrasts with the private harvest of timber on public lands, for instance, in which case the firm must pay a fee based upon the amount of lumber removed.

To acquire a "valid claim" to public lands, a mining company must only demonstrate that a "prudent man" would be justified in further expenditure of funds and effort in an attempt to develop the minerals which it has discovered. Once claims are validated by the federal government, the firm may obtain full title and deed to the land. Again, without any payment.

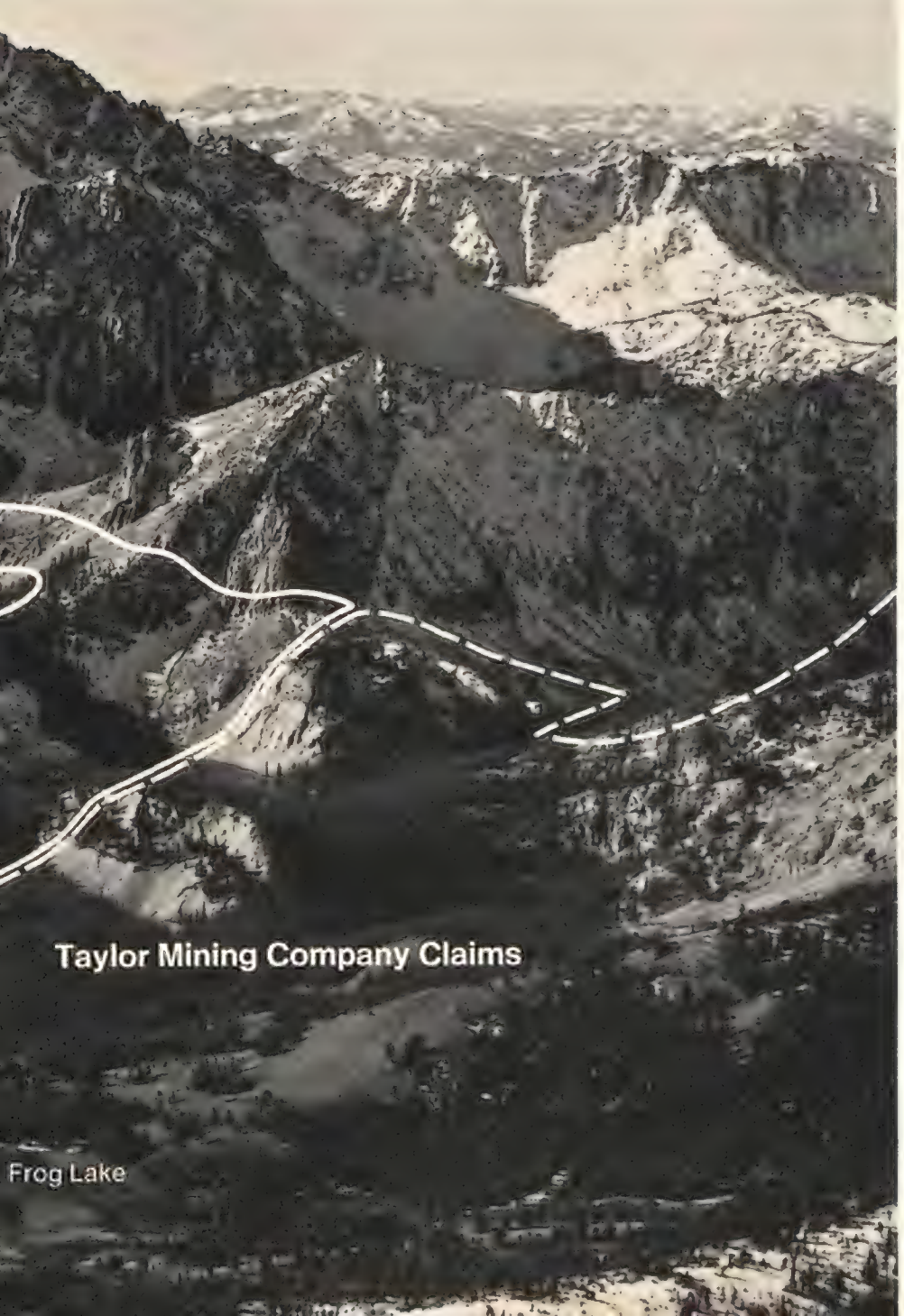
In the White Clouds, the claims of ASARCO and of two other firms that have begun mineral exploration in the area are yet to be validated. Proponents of the new national park hope that the area will be granted park status before validation occurs. If claims were validated, Congress might not create the proposed park. Or, if the park were authorized after validation of the claims, the government could be placed in the strange (and costly) position of having to purchase these claims from the mining firms.

In March 1969, ASARCO requested a Forest Service permit to build an eight-mile access road from the East Fork of the Salmon River, along Little Boulder Creek, into the proposed mine site. The road would be used to remove bulk samples of molybdenite for further testing, and later would be widened to accommodate fullscale operation.

The Forest Service elected to hold public hearings. During the month of May, three hearings were held and, as expected, conservationists condemned the proposed molybdenum mine venture, while ASARCO officials, Idaho's governor and the state's mining interests applauded the mining venture's likely contribution to the state economy ("Scenic grandeur and tourism alone will never sustain this state"). The majority of testimony opposed creation of the mine.

In following months, Forest Service officials deliberated the application for an access road and again chose middle ground. They announced—as federal agencies will when placed in a situation of conflict—that they would conduct a study to determine long-range management goals for the White Clouds area.

Governor Samuelson, impatient with the delay,



Tailings pond at the American Metals Climax mine in Climax, Colorado, provides a forecast of how Little Boulder Creek's valley might look.

launched repeated attacks upon the Forest Service ("The administration of the Forest Service in this district stinks to high heaven!" "If you had just issued a permit for the road, there would have been no controversy.") and then stated that conservationists' attempts to "lock up" natural resources within parks would contribute to a series of economic and social ills within the state, ranging from its lack of kindergarten education to its rising property taxes. Conservationists countered by publicly asking for the Governor's resignation, suggesting that this "would provide a constructive end to your term in office and . . . could . . . restore dignity to state government in Idaho."

The verbal battle continued through the autumn of 1969 and into 1970, repeatedly receiving headline coverage by the state's newspapers. An official of the Idaho Bureau of Mines labeled conservationists "hysterical preservationists" and they in turn described the miners as "gouge-and-run bulldozer boys." By degrees, the controversy became more impassioned.

During the battle, Idaho's Senator Frank Church, Senator Len Jordan and Representative Orval Hansen proposed a 500,000-acre National Recreation Area in the Sawtooth/White Clouds area. The recreation area would remain under control of the Forest Service which would be granted power to regulate the operation of future mining claims (those established after passage of the bill) within the region. The proposal was passed by the Senate but not the House.

Miners supported the bill. From the point of view of most conservationists, the Church-Jordan-Hansen bill is ineffective, since it would not prevent development of existing mining claims. Senator Church admitted the bill's weakness, but said he felt Congress would not pass a stronger measure.

The Greater Sawtooth Preservation Council, undaunted by the intricacies of political reckoning, quickly completed its proposal for a large national park. The plan they now offer encompasses 1.3 million acres (about the size of Everglades National Park in Florida), including the Sawtooth and White Clouds areas, along with other nearby mountain regions and the scenic valleys among the separate ranges.

The language of the proposal was adapted from the 1968 legislation that created the North Cascades National Park in the state of Washington. It includes provisions for roadless mountain wilderness regions at the core of the park (roughly 750,000 acres), surrounded by "recreation areas" (550,000 acres) in the mountain foothills and within large grassy intermountain valleys where a few state roads and private homes now exist. The recreation areas would contain developed campsites, picnic grounds and park buildings, and would generally be managed to absorb a higher intensity use than the wilderness regions.

About ten percent of the land within the proposed recreation area is now privately owned and could be purchased by the federal government or zoned to prevent billboards and housing developments and other activities that would detract from the area's scenic qualities. The remainder would merely be transferred from the Forest Service to the National Park Service, requiring no outlay of federal funds.

Their proposal completed, the Greater Sawtooth Preservation Council and its allies assumed a more aggressive role. Stating that the proposed molybdenum mine was ". . . not just a crime against nature, but a bum business deal," Russell Brown, the Council's vice president, presented figures indicating that tourist income from Idaho's first national park (an estimated $10 to $20 million annually) would greatly exceed the state income derived from the mining operation. Brown also emphasized that while the mine would be exhausted within 30 years, tourist income from the park would persist into the future.

The Idaho press gave extensive coverage to the park's favorable economics. Powerful conservation organizations—the Sierra Club, the Wilderness Society and the National Wildlife Federation—lent their support to the proposal, and, in August 1970, at another set of hearings, a majority of the testimony urged Idaho's congressmen to support the Council's plan.

Following the August hearings, the White Clouds became an important political issue in Idaho. The League of Conservation Voters (political arm of Friends of the Earth) joined the other conservation groups in support of gubernatorial candidate Cecil Andrus, an outspoken opponent of the proposed mine. On November 3, Idaho turned Governor Samuelson out of office. Virtually unknown for centuries, the White Clouds were singled out by two major television networks as the prime issue in the

Frog Lake, cold and quiet in the early morning, is threatened by Taylor Mining Company claims.

Governor's defeat, and *The New York Times* called the Idaho results the "most sensational, perhaps, of the environmentalists' Election Day triumphs."

But as of December 1970, the Council's proposal still had not been introduced into either house of Congress. Instead, Idaho's congressional delegation had previously introduced a "compromise" bill to create a park about half the size of the one proposed by the Council. This bill died with the end of the 1970 session but it is assumed that it will be reintroduced sometime in 1971.

Throughout, ASARCO has stressed its intention to minimize the environment impact of its mine. The firm began to survey the means of limiting the ecological damage of the mine, tailings pond and access road, and, in March 1970, announced the suspension of its exploratory drilling until its own study and that of the Forest Service could be completed and evaluated. In addition, the company said that in 30 years, when the mine was abandoned, the large open pit would naturally fill with groundwater and could be stocked with trout and used for public recreation.

Even though ASARCO has taken precautions to reduce ecological damage during their exploratory drilling, conservationists suspect the company's environmental intentions. They reported that five of ASARCO's plants—in Washington, Montana, Texas, Arizona and California—were causing pollution problems and that in four of these locations private citizens or air pollution agencies had leveled lawsuits against the company. Checking into the possibility of converting the expired molybdenum mine into a lake, they found that a similar attempt at a New Mexico mine operated by the Molybdenum Corporation of America was unsuccessful.

A letter from that state's Department of Game and Fish stated that trout stocked into the mine's tailings pond had died within a matter of a few hours, due to lack of oxygen in the water, and said that ". . . It is not as easy to reclaim these areas as . . . the mining industry would like to lead us to believe."

A memorandum from an official of the U.S. Bureau of Sport Fisheries and Wildlife forecast that the entire run of salmon in the East Fork of the Salmon River would be destroyed by the proposed mine. The statement warned that despite any efforts ASARCO might make, it would be virtually impossible to prevent pollution of the region's streams by toxic materials that would leak from the pit and tailings pond.

The battle will continue until the region's status is resolved. The next decision in the controversy—probably the final decision—rests with the lawmakers. Sometime this year Congress will decide the region's future—by creating a large national park, by rejecting the park and permitting mining, or by affecting some compromise.

In making its decision, Congress will have a great deal of information at its disposal: pollution statistics, estimates of potential environmental damage, projections of the relative economic benefits of a park or mine. But when one tries to conceive of some of the questions that might influence a decision of this sort, it still seems that whatever choice is made will inevitably be arbitrary and highly subjective.

By what proportion, for instance, would a visitor's enjoyment of the White Clouds region be diminished by the presence of a molybdenum mine? By 5 percent? By 51 percent? By 99 percent? Is there a cutoff point along this spectrum—a point at which a park would clearly be of greater social value than a mine? How many creatures would perish as a direct or indirect result of a mine? Is this a relevant consideration? Can, or should, the human value system be broadened to encompass the welfare of lower animals, or trees, or slabs of granite? How much park space or scenery or solitude does society need? How much molybdenum or high-speed machinery? In 50 years, how much? In

500 years? Do we expect our resources, or our species, to persist for that length of time? Is it our duty, or even our privilege, to plan that far in the future?

Aside from any moral, political or perhaps metaphysical considerations, judgment of the best course of action in the White Clouds depends largely upon one's conception of the necessary direction of human society. As with most land-use conflicts, the White Clouds controversy is as much a confrontation between contrasting views of future human needs as it is a local battle between miners and conservationists.

The latter group, for instance, points out that this country annually produces about 100 million pounds of molybdenum, while consuming and stockpiling only about 70 million pounds annually in domestic production. The remainder is exported. Thus, they say, the White Clouds mine would only add to the production of a domestically surplus metal.

While admitting that molybdenum is not now in short supply, miners say that they are looking into the future to a time when the continued expansion of American industry may create demands for this metal that will exceed the amount that can be supplied by existing mines. In their evaluation of the full spectrum of future social needs, they feel that unless our resources are more fully developed ". . . Growth, progress, and our very pursuit of happiness will be in serious jeopardy as the population continues to explode and demand more materials. . . ."

This argument assumes that our population and our demands for material goods will inevitably continue to grow. It concludes that the most farsighted way to cope with this situation is to attempt to satisfy these demands with expanded production.

This is a common argument. Unhappily, the facts of the real world do not necessarily support its conclusion. History shows that expanded production tends to expand consumption and probably the most fundamental lesson of environmental science is that our planet contains a finite supply of resources. Some of these can be recycled or reused or regrown but, in time, all resources will be exhausted by unlimited growth in population and consumption.

For very understandable reasons, many political and economic spokesmen choose to restrict the definition of the "environmental crisis" to the problems of litter and pollution. But most members of the scientific community who deal with environmental issues see the real challenge as one of providing human societies with sufficient incentives to curtail their consumption and population growth before resource shortages become critical. As an approach to the future, they emphasize the need for socially imposed production and consumption quotas for nonrenewable resources. They point out that quotas would have the immediate benefit of rationing the limited resource pool. They would also help to create a greater social awareness of resource scarcity and of the necessity for further change in consumption patterns. With this awareness, they hope, society may become more willing to limit population growth. Similarly, they emphasize that attempts to meet all of society's material demands—in addition to being futile—only serve to conceal the need for these changes.

A modest tightening of the belt

In this sense, creation of a national park in the White Clouds would remove a portion of the American landscape from the realm of industrial expansion, and thus would provide a modest sort of quota upon metals production. But without social support and governmental direction, it would be unreasonable to expect the corporate world to take this approach. Probably it would be a little unjust to expect ASARCO to tighten its own belt (before others tighten theirs) to embrace new priorities.

Whatever the outcome in Idaho, there will be more White Cloud controversies—in Nevada, in Texas, in Michigan, even in places like New Jersey where little is left to battle over. More politicians will lose their jobs over such questions. And, as in Idaho, the frenzy and subjectivity of the day-to-day conflict will tend to obscure the more basic forces at work, will tend to create the impression that all such controversies are little more than battles between "hysterical preservationists" and "gouge-and-run" developers.

Little Boulder Creek flows cold and clear.
Under the miners' plan, it would be dammed.

By Gloria Lubkin

Chien-Shiung Wu, the first lady of physics research

With skill that inspires the awe of her colleagues, she proved a basic law of physics to be incorrect

Madam Wu at home: delicate flowers, the crisp tracery of a Chinese dress, a tenacious mind probing the heart of the nucleus.

The middle-aged Chinese lady emerged from the salt mine near Cleveland, Ohio, and smiled when she saw the daylight once more. Perfectly groomed, as always, in her traditional *cheong-san,* she had spent the better part of the day 2,000 feet down in a small house that protected her colleagues and their equipment from the hydrochloric acid fumes produced in the crystalline cavern. Deep in the mine, shielded from the rain of radioactivity and cosmic rays that constantly fall on the earth, racks of apparatus had been installed in the house to determine whether a radioactive substance ever emits two electrons at the same time.

This elaborate experiment was one of many in the career of Dr. Chien-Shiung Wu, who has been called the greatest living woman experimental physicist. An earlier experiment on radioactive decay of cobalt-60 had overthrown one of the most fundamental laws of physics; another had helped to explain why the first large atomic pile stopped running a few hours after it reached a critical mass. Unlike many physicists who tend to retire from the rat race of active research at age 40 or so, Dr. Wu is still a leader in experimental physics. Now 57, she is today applying her skill and imagination as a nuclear physicist to a serious and long-neglected medical problem—sickle-cell anemia. "I've always felt that in physics you must have total commitment," she says softly. "It's not just a job. It's my whole life."

Madam Wu lives only a block away from Columbia University and her laboratory in the Pupin physics building. In her spacious apartment, amid a collection of Chinese art and furniture combined with modern American pieces, she often entertains—in honor of a student receiving a Ph.D. or to introduce colleagues to a visiting scientist. Her kitchen is filled with gadgets for cooking in the Chinese style. She is so devoted to fine Chinese cooking that when a favorite restaurant chef moves to a new job she follows. Her graduate students recall the custom of lunching with her on Fridays at one of the nearby Chinese restaurants.

Last year she had ten graduate students. She works her students hard and sends them proudly off to careers in high-energy physics research, teaching and medical research. "She demanded a lot," one student recalls, "and gave as much and more than she demanded. She didn't ask us to work, but she was working all the time and she certainly expected people to work hard." When they were running an experiment, they might work continuously for one or two days

Gloria Lubkin, herself a trained nuclear physicist, is Physics Today*'s senior editor for scientific and political news.*

straight and Dr. Wu would stay the whole time. Normally she spends the day in her laboratory and office, coming in at 9:00 A.M. and leaving at 7:00 or 8:00 P.M.; often she continues her work in the evening, either at home or in the lab. "Sitting around or walking I think about my work; usually those are the best moments."

Growing up in Shanghai, where her father was a school principal, she and her two brothers were encouraged to read and to explore the world around them. An early interest in solving puzzles made her think of becoming a mathematician, but at National Central University she became absorbed in physics. After writing her senior thesis on X rays, she decided to come to the United States for a Ph.D.

Originally she planned to attend the University of Michigan, but when she found that the campus had about 500 students from China she decided against it. "I wanted to learn everything about the United States . . . to absorb the American way of life," she says. At Michigan, she felt, she would stick too closely to her countrymen. So she enrolled in the University of California at Berkeley, where the Chinese students were mostly native Americans.

It was a particularly exciting time in physics and physics was particularly exciting at Berkeley. Ernest Lawrence had recently invented a new machine to smash atoms—the cyclotron. Chien-Shiung became a student of Lawrence at the Radiation Laboratory and received her Ph.D. in 1940.

In 1939 the German scientists Otto Hahn and Fritz Strassmann had discovered that the uranium atom could split roughly in half with the release of large amounts of energy. Then the Austrian expatriates, Lise Meitner in Sweden and her nephew Otto Frisch in England, correctly interpreted this as fission. The news reached Berkeley and with it a host of new problems to be pursued. Chien-Shiung set to work to discover the lifetimes of the noble gases emitted when the uranium nucleus split. Meanwhile, American scientists had agreed among themselves to refrain from publishing any new information on uranium fission, and as a result Madam Wu's work was not known beyond Berkeley.

Physics in an auto showroom

Among themselves, however, the physicists at Berkeley were openly discussing the possibilities of fission. Robert Oppenheimer asked Dr. Wu to give a colloquium talk on the subject and,after an hour on pure physics, Chien-Shiung discussed the feasibility of a chain reaction and the possibility of "a catastrophe." "Now I will stop here. I will go no further," she said, drawing an appreciative laugh from Lawrence. But Dr. Wu did go further.

Before long she was at Columbia University working on the Manhattan Project, helping to invent and develop the atomic bomb she had hinted at in the colloquium. In an automobile showroom converted into a laboratory, she helped develop a diffusion process for enriching uranium ore for producing large quantities of uranium-235. After Enrico Fermi built the first atomic pile under Stagg Field at the University of Chicago in 1942, another pile was constructed at Hanford, Washington. Mysteriously, the chain reaction stopped a few hours after start-up. Fermi had suspected that one of the substances produced by fission was capturing most of the neutrons, thus halting the reaction. "Ask Miss Wu," Fermi was told. It turned out that one of the noble gases studied by Chien-Shiung at Berkeley was the very isotope that was poisoning the chain reaction. Once the poison was known, the antidote was found and the pile continued to operate.

In 1942, after a long-distance, long-term courtship, Chien-Shiung had married Luke Yuan, a fellow graduate student from her days at Berkeley. They moved to the East, she to a teaching job at Smith College in Northampton, Massachusetts, and he to

work on radar development at R.C.A. Research Laboratories in Princeton, New Jersey. They managed to meet periodically in New York City, establishing a pattern they still follow today. The next year she moved to Princeton, where she taught an advanced undergraduate physics course. Despite her great love for teaching, she missed research and, when she was asked to join the work at Columbia, she seized the chance. After the war, in 1947, the Yuans had a son, Vincent, and with the aid of a housekeeper Chien-Shiung continued her research at Columbia just as she had before her son's arrival. Her husband is now a high-energy physicist at Brookhaven National Laboratory on Long Island.

At her Columbia laboratory, Dr. Wu became deeply involved in the study of beta decay, a form of radioactivity in which electrons are emitted. Obtaining precise measurements of beta-decay properties is extremely difficult. Dr. Wu became the world's foremost authority on the subject and her book, *Beta Decay,* written with Steven Moszkowski, is the standard reference for nuclear physicists. Her experiment in the Ohio salt mine, which showed that two electrons are not emitted by a nucleus at the same time, was part of her work in beta decay.

One of her collaborators at Columbia at the time was a young Chinese theoretical physicist, Tsung-Dao Lee, who was interested in so-called "weak interactions," of which beta decay is one. "In her field," says Dr. Lee, "Chien-Shiung Wu's record is unique. She has virtually never made a mistake in her measurements." At scientific meetings, where experimental results are regularly called into question, one often hears the phrase, "Of course, if these measurements had been made by Madam Wu, there would be no doubt."

Meanwhile, in the 1950s, with a new generation of cyclotrons and other kinds of atom smashers, physicists were producing new kinds of particles, called K-mesons. It was discovered that two kinds of K-mesons, called tau and theta, had exactly the same mass and other properties, yet produced different particles as they decayed. To explain this phenomenon, Lee at Columbia and Chen Ning Yang of the Institute for Advanced Study at Princeton proposed that nature might not be symmetrical.

One of the fundamental laws of physics, the law of conservation of parity, said that if you perform an experiment and then do exactly the same experiment but reverse left and right, you should get the same result. When electrons are given off from nuclei, for instance, they should be given off equally in all directions. The law was so obvious, so self-evident, that nobody had ever tested it. Like the laws of conservation of energy and momentum, which are based on the belief that time and space are uniform and isotropic,

Nature, Dr. Wu proved, can distinguish between her left hand and her right.

the parity law assumed that nature does not know her left hand from her right hand. And all three laws appeared equally fundamental.

Lee told his old colleague Dr. Wu that he and Yang had determined theoretically that in weak interactions the parity law need not apply. They discussed the possibility of a beta-decay experiment to test parity. It was the end of May in 1956, and the Yuans were about to go to Geneva and then to the Far East on a lecture tour. Chien-Shiung asked her husband to go without her. She had to do the experiment immediately, before the rest of the physics community realized the importance of the parity experiment and did it first. Although she felt the probability was tiny that the law was wrong, she urgently wanted to make a clear-cut test. And the experiment itself was a difficult and challenging one to design.

An ordinary cobalt-60 source emits tens of thousands of electrons every second. On the average, the number of electrons emitted in all directions is the same. Applying a magnetic field tens of thousands of times greater than that of the earth will make the individual magnet inside each cobalt nucleus try to line up with the magnetic field, but at ordinary temperatures random motion destroys the alignment. When the temperature approaches absolute zero, however, the nuclear magnets stay lined up like soldiers at attention.

The magnetism of a nucleus is associated with its spin. So when all the magnets are aligned, you can think of all the nuclei as a bunch of tops spinning in the same direction around axes that are parallel. If you were to look in a mirror at the system, you would see the "left-handed" version of it with all the spins going the other way. Another way to visualize left-handed and right-handed versions is to look at the tops first from above and then from below. Thus an experiment that gave a different result in one direction along the magnetic field from what it gave in the opposite direction would be detecting a difference between a left-handed and a right-handed system.

For example, if one were to count the number of electrons ejected in various directions, provided parity is conserved, the number of electrons in every direction will be the same. Dr. Wu convinced a group of physicists at the National Bureau of Standards

(including Ernest Ambler, Raymond Hayward, R.P. Hudson and Dale D. Hoppes) to collaborate with her. The Bureau had one of the few laboratories equipped with the low-temperature apparatus required.

The experiment showed that the number of electrons was not the same in all directions, that more were emitted in the direction opposite to that of the aligned nuclei. That is, nature distinguished between left and right. Thus Dr. Wu had shown one of the basic ideas in physics was wrong, that many phenomena could in fact differentiate between left and right.

Yet, Dr. Wu was torn by doubts. She approached her results with her typical single-minded tenacity. ("In this field, you have to be tough-minded," says her colleague, Dr. Lee.) By mid-December other experimenters at Columbia and the University of Chicago soon confirmed the overthrow of parity conservation by testing the law in meson decay. "I usually don't let other people influence me," says Dr. Wu. "Even after they saw it in mu-meson decay we weren't relaxed. We had to be convinced ourselves." She could not sleep nights, turning over in her mind all the possible alternative explanations for her results. Weeks passed before she was finally convinced that there could be no other explanation.

Columbia called a press conference on January 16, 1957, and the overthrow of parity was announced to the world—the first time in the history of physics that an experiment was conceived and carried out to overthrow a basic law.

The very same year Lee and Yang were awarded a Nobel prize for their theoretical work on the overthrow of parity. Although Dr. Wu did not share the prize, she was soon showered with many other honors and awards, including the Comstock prize from the National Academy of Sciences, awarded only once every five years (she was the first woman to receive this award), the Research Corporation Award and the Franklin Institute Wetherill Medal. She received honorary Doctor of Science degrees from many universities in the United States and was elected to the Royal Society of Edinburgh as an honorary fellow. In 1965, she traveled to Taiwan to accept a $10,000 prize from the Chi-Tsin Culture Foundation, and then gave the money to the China Institute of America so it might be used for scholarships to encourage other Chinese students.

Dr. Wu's latest scientific adventure is in biophysics. "Living and working near the edge of one of America's largest black communities [Harlem], we were gravely concerned when we learned of the plight of those who suffer from sickle-cell anemia." In this hereditary hemoglobin disorder—which afflicts Negroes almost exclusively—the blood cells, instead of remaining round, assume a crescent shape and clog the small capillaries. Painful for the victim, it was also hopeless until last year. Recently, a biochemist described the molecular structure of the hemoglobin molecule involved with sufficient detail that medical researchers were able to develop a clinical treatment that blocked and reversed the sickling in 25 cases.

Meanwhile, research also continues on the fine structure of the aberrant hemoglobin molecule. Dr. Wu and her colleagues, Y.W. Chow, Paul Swerdlow and Ruth Howes, are cooperating with Dr. John Bertles of the St. Luke's Hospital Center in New York. Using the techniques of nuclear physics to compare the electrical field of the iron atom in normal hemoglobin with that of sickle-cell hemoglobin, they seek additional insight into the molecular changes that cause the sickling phenomenon. Dr. Wu remarks, "This type of research demonstrates that even the most sophisticated and seemingly remote basic nuclear physics research has implications beneficial to human welfare."

The case for women in physics

"I wish there were more opportunities for women in science," says Dr. Wu. In physics, she notes they have made a far greater contribution than one would expect from the number involved. Marie Curie was the only person to receive two Nobel prizes in science; she received one in chemistry and shared another with her husband, Pierre, in physics. Her eldest daughter, Irène Joliot-Curie, shared a Nobel chemistry prize with her husband, Frédéric, for discovering artificial radioactivity. Maria Goeppert-Mayer shared the Nobel prize in physics for the theory that particles inside the nucleus are arranged in shells, something like the layers of an onion.

"Never before have so few contributed so much under such trying circumstances!" says Dr. Wu.

In her laboratory at Columbia University, Dr. Wu notes that women in physics have contributed more than one would expect from their small number.

Gisbert Combaz, *Promenade en bateau,* 1911. This is a sketch in his characteristic style, although the purpose for which it was intended is unknown.

All posters courtesy of L. Wittamer-De Camps

'La Belle Epoque' returns to life in Belgian posters

The revived interest in Art Nouveau will be further sparked by an exhibition of posters now touring the country

In this country the decades before and after the turn of the century are given such roguish labels as the "Gay Nineties," the "Naughty Naughts" and so on. But in Europe the period is more elegantly known as *La Belle Epoque*. Its most characteristic expression was the short-lived but distinctive decorative style now commonly called Art Nouveau, although it had other names in other places—*Jugendstil* in Germany, *Sezessionsstil* in Austria, *Modernismo* in Spain and, among those who didn't like it, *Bandwurmstil,* meaning "tapeworm style."

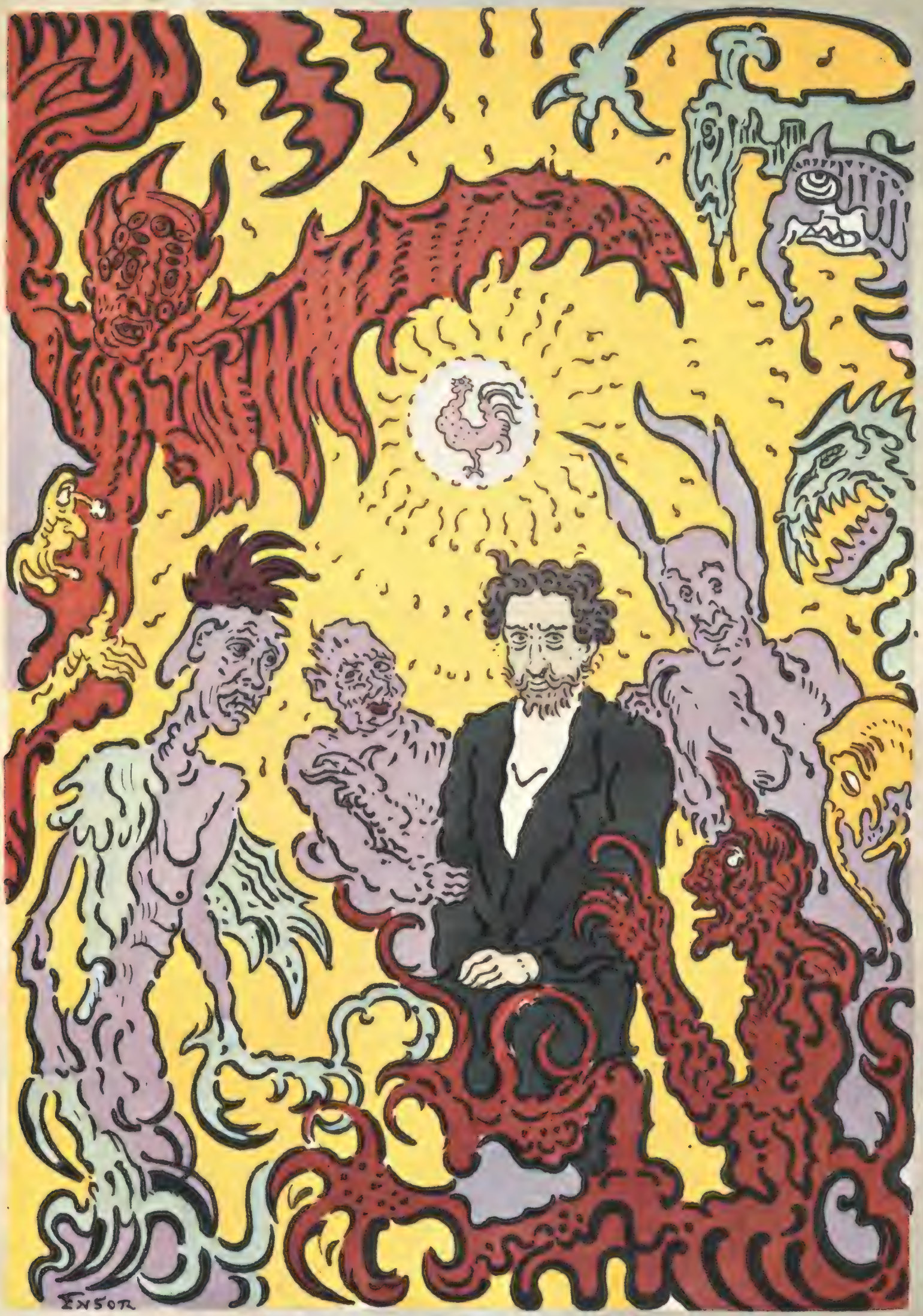
At the time, Art Nouveau *was* new; it owed nothing to the past, except possibly, in some applications, a debt to the Japanese woodcuts that were then becoming known in Europe. In fact, one of the earliest manifestos of the new movement declared: "no concessions to the public, no courting of power, no borrowing from the past." Yet the public took to it wholeheartedly, and its pervasive influence may be seen in buildings all the way from Brussels to São Paulo, and in furniture, silver, glass, typography and women's fashions.

Long despised, if only because it was the style our parents grew up with, Art Nouveau has had an enthusiastic revival in recent years. This is at least in part because revivals in taste and fashion succeed each other so swiftly these days that we are catching up with our own times, but also partly because the young have found in Art Nouveau's sinuous lines and dissolving forms an accommodating vehicle for their psychedelic

Salon des Cent
31, rue Bonaparte, PARIS

EXPOSITION
en Décembre 1898
DE L'ŒUVRE DE

JAMES ENSOR



fantasies. A whole industry has grown up devoted to producing psychedelic posters in a style that might be called *le nouvel art nouveau,* usually printed in fluorescent inks not available to the original practitioners of the style, and sold in shops that also sell love beads, peace symbols, and inflatable plastic furniture.

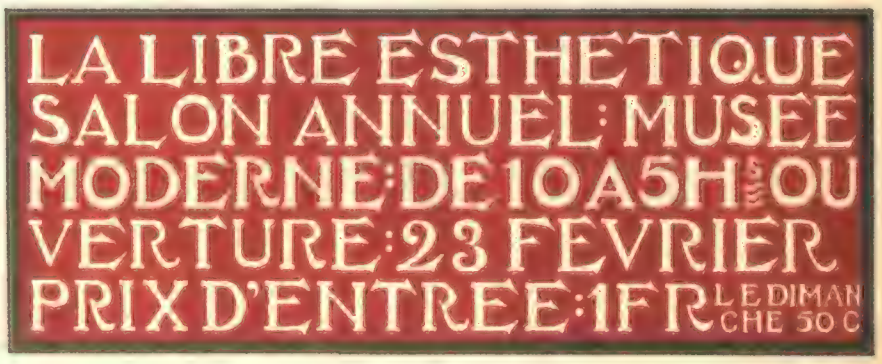
In line with the boom in Art Nouveau ($3,250 for a Tiffany glass vase in 1966, more if it were offered today), an exhibition of posters from the period is currently circulating through the United States under the auspices of the International Exhibitions Foundation. It has already been seen at the Library of Congress, the University of Pittsburgh and the Toledo Museum of Art. Still to come are the Columbus Gallery of Fine Arts, January 15-February 15; UCLA, March 1-31; University of Illinois, April 15-May 15; Phoenix Art Museum, June 1-30; Georgia Museum of Art in Athens, July 15-August 15; Milwaukee Art Center, September 1-30; and the Delaware Art Center in Wilmington, October 15-November 15.

Nouveau living, nouveau art

These posters are from the collection of M. and Mme. Louis Wittamer-De Camps, who live in what is probably the supreme application of the principles of Art Nouveau to architecture, the Hôtel Solvay in Brussels. It was designed by Victor Horta and built between 1895 and 1900. Living in such a setting, with its extraordinary ironwork, glass and silver, the Wittamers decided that it lacked only one aspect of Art Nouveau: the graphic arts.

It can be argued that Art Nouveau was invented in Belgium, that it reached its full flowering there and that in the poster it achieved its finest expression. The poster is a form of advertising that today is confined mostly to subway and railway stations in metropolitan centers. But in the 1890s it was so new and the techniques of lithographic printing were so improved that the designing of posters attracted major artists, especially those of the avant-garde. Poster collecting became a mania, and the artists, responding, began to design posters that were not intended to sell anything.

Brussels saw the founding of the sonorously named *Société Nationale de l'Art appliqué à la Rue et aux Objets d'Utilité Publique* (National Society of Art Designated for Streets and Objects of Public Utility). According to Yolande Oostens-Wittamer, who is the Wittamers' daughter and prepared the informative



Gisbert Combaz, *La Libre Esthétique,* lithograph, 1899. "The Free Esthetic" was a group that lasted 10 years and held important exhibitions.

James Ensor, himself, in *Salon des Cent,* lithograph, 1898. The Salon of the Hundred was a Paris hall that also published posters and reproductions.

catalog for this exhibition, the Society's activity was only symbolic, but it spoke for the great preoccupation of the time: art everywhere, art for everyone. Thus the poster, instead of confining itself to advertising, surpassed its assigned role and became art.

On the whole, Mrs. Oostens-Wittamer goes on, posters strove to give meaning to the events of everyday life. "Woman, omnipresent, gave inspiration; she expressed the dreams, the hopes, the discoveries, the surprises, the enthusiasm, and even the worldliness of the period. Transposing nature into abstractions did not interest most of these artists, nor were they uncompromising social realists. These men composed with simplicity and tenderness and they fell in love with everything they saw."

Who they were and what they did

Whether or not everyone can read all of that into the posters reproduced in these pages, they are typical works by some of the most important poster artists who functioned in *La Belle Epoque*.

Among them is Gisbert Combaz. An orientalist, many of his designs have the flat, bright colors of Japanese woodcuts (page 58); others show the nervous arabesques and twining forms that one automatically associates with Art Nouveau (page 61 and the fluted hems of the lawyers' robes on page 64).

Then there is James Ensor, the celebrated Belgian expressionist, best known for his painting *The Entry of Christ into Brussels*. His poster for an exhibition of his own work in 1898 (page 60) shows himself tormented by demons, as indeed he was.

Another prolific poster artist was Léo Jo (pages 62 and 63), whose full name was Léontine Joris. As a child she began making caricatures, which were shown to a prominent sculptor of the day; he encouraged her but refused to give her lessons for fear of stifling her talent. She was, therefore, self-taught. Described as "a charming, petite young lady," Léo Jo was also cultivated and witty (she designed a game of ninepins in which all the pins were prominent public figures). She died in Brussels only eight years ago at the age of 92.

Henry Meunier's posters are bold and dramatic, with strongly opposed light and dark values and large, flowing masses of color. The one shown here (page 64) was designed in 1898 as an advertisement for the postcard publisher Dietrich. The postcard had been invented only 29 years before, and was entering its golden age; in 1899, 12 million cards were printed in Belgium for a population of 6.2 million. The Dietrich firm, which was Brussels' first art bookstore, commissioned postcards from artists of the highest quality.

Théo van Rysselberghe was widely known as a painter but designed only a few posters. The one reproduced here (page 65) is typical of his work. As Mrs. Oostens-Wittamer says, "The elegant feminine figures of his posters, very knowingly placed on the page, seem to be the pretext for Van Rysselberghe to balance large spots of red-orange against their greenish or bluish complimentaries. The text is beautifully drawn and gracefully integrated into the design of the poster."

Together, these and the other artists represented in the exhibition *La Belle Epoque* testify to her assertion that "The freedom of expression of this new genre [the poster], which played a secondary role to painting and architecture, liberated the boldness of some artists and the audacity of others. Many artists recaptured their spontaneity in posters."

Léo Jo, *Le gentleman au verre,* gouache on heavy paper, no date. Inscribed *Vita brevis, ridendo eamus* —in effect, "It's a short life, so laugh it up."

Léo Jo, *Le couple,* gouache on heavy paper, no date. Although its purpose is unknown, this sketch is a good example of her strong line and bold colors.

Henri Meunier, *Cartes postales artistiques,* 1898. This is a sketch for a poster advertising the postcards published by a Brussels art bookstore.

Above: Gisbert Combaz, *Premier Congrès International des Avocats,* 1897. The preliminary sketch for a poster hailing an international conference of lawyers.

Opposite: Théo van Rysselberghe, *La Libre Esthétique,* lithograph, 1897. On the right is the wife of Octave Maus, leader of the Free Esthetic group.

LE
QUATRIÈME SALON
ANNUEL DE LA LIBRE
ESTHÉTIQUE SERA
OUVERT TOUS LES JOURS DE 10 A 5 HRES
DU JEUDI 25 FEVRIER AU JEUDI 1 AVRIL 1897
AU MUSEE MODERNE PLACE DU MUSEE
ENTREE: UN FRANC LE DIMANCHE 50 CENTMES

Book reviews

Beastly Inventions
Jean Craighead George
(David McKay Company, Inc., $6.95)

Jean Craighead George is daughter and sister of professional naturalists. She studied zoology and botany in college, worked with laboratory and field researchers in those fields and became a writer with special skills in popularizing natural history, particularly for younger readers. In this book, she is writing for all ages. She calls her book an "animal Hall of Fame."

Her purpose, she indicates, is to present "an unplanned testimony to animals" whose "genius . . . lies in their remarkable ability to adapt to every niche on earth." And she adds, "Man does not seem to take his place in this strange scheme of things. . . . He is comparatively primitive in contrast to the specialized families. He must 'think' his way back to the wisdom and ingenuity of lower animals by studying their secrets, and this is a long, unmarked trip through zoology to chemistry, biochemistry and physics."

She undertakes to guide the reader on an abbreviated trip into those areas. The chapters deal with such big topics as the sculptors of form, ingenious ways of travel, courtship and sex, unusual homes, parenthood, food and eating, strange senses, deceit and aggression, and adaptations to life with man. Some of these chapters have a gee-whiz air in dealing with the unusual. Other chapters, notably those on courtship and on strange senses, present offbeat and little-known information with skillful yet colorful directness.

By its very nature, this is a book that makes the most of the bizarre. Mrs. George says that a mosquito's chitin beak "literally looks for a capillary" when it enters human flesh. She says some sea urchins are so light-shy—and so ingenious—they pick up pebbles and hold them up to cast shadows when caught in flashlight beams. She would like to think flowers shaped the flight capacity of hummingbirds. In discussing sexual patterns, she notes that house sparrows are intensely sexed. One pair of sparrows mated 14 successive times. And she tells what a mammologist said about the mating of porcupines—they mate without touching quills and they do not mate often.

This really is a kind of grab bag of zoological information. The best of its material is interesting, sometimes entertaining, sometimes fresh. Quite a bit of its material will be familiar to the informed amateur naturalist. The best bird stories, for instance, can all be found in Joel Carl Welty's scholarly *The Life of Birds*. Much of the courtship and sex material can be found in any good zoology textbook. But when brought together here, these unusual stories do make good pick-up and lay-down reading. And several times Mrs. George contributes an idea to pause at and chew on—such as the flower-hummingbird theory. Or the idea that a colony of social insects is a biological entity and individual bees, or ants, are only specialized, mobile cells. One wishes for more such thinking and more than passing comment.

This is not serious science, nor was it meant to be. It is a kind of wonder-book with gleams of solid substance here and there. The section on strange senses and what they sense is perhaps the best and most meaty in the book, for the author here reaches out beyond the routine to understand and transmit to her readers something of what insect eyes see, for instance, how pit vipers locate prey and how catfish smell with their skin.

She does indulge in the flat statement which has it perils. She says of the diet of beavers that "in winter it is strictly the bark of aspens and willows." The fact is that hungry beavers readily eat the bark of any poplar and even of elm and oak. And there are other instances of too-pat answers and the offhand use of "always" and "never," which are ready-made traps.

All in all, then, this book is somewhat more than mere entertainment, yet less than solid information. And it doesn't really "think" its way back to more than a smattering of the "wisdom and ingenuity of lower animals." At its best it may provoke some readers to do deeper reading and thinking. At its worst it is just a cut above the banal.
—Hal Borland

To Purge This Land with Blood
Stephen B. Oates
(Harper & Row, $10)

The age-haunted mountains and the rivers that enclose Harpers Ferry will long conceal the mystery of John Brown. Dragging his nightmare across the land, he was touched with that universality that combines every conflicting element of human personality. He was a wise man and a fool; violent and tender; truthful and secretive; a fanatic, at best iron-riveted to his own will, but deeply involved with his personal notion of God's will.

At least his *cause* is clear, and his obsession understandable. But the hideous methods that marked his attempts to free the slaves clash with the humanity of his dream. Don't say he was a good man or a demon. Better say he was a powerful mixture of both. The ingredients are inseparable.

Mr. Oates knew the mystery of Brown—his superb study uses an opening page for one line: "He was always an enigma," a quote. He knew that attacks would beset anyone taking a middle view of Brown, explaining "... this book is neither an indictment nor a eulogy of Brown. Nor is it a psychoanalytical case study that attempts to decide once and for all whether Brown was 'sane' or 'insane.' One must seriously question whether psychoanalysis, still an imprecise discipline, is a valid approach for the biographer or the historian." The evidence "regarding Brown's alleged 'insanity' is too partisan and controversial for use in clinical analysis."

This book, the first on John Brown based on original research to appear in 60 years, could not have been more dispassionate and objective. It is easy to say that here is the last word. But it won't be, because mysteries are too alluring. Several things, indeed, provoke wonderments. How could such mighty personalities and intellects as Emerson and Thoreau have any truck with such an obvious madcap as Brown? Could they have believed that this man was capable

of raising an army of slaves and routing those unwilling to fight up through the mountains and into Canada without raising U.S. military might?

Of course, Brown had not told them the whole truth. He related the bloodbath in Kansas, but placed no blame for the murders, which he had instigated, upon himself. The New Englanders were profound abolitionists and had wearied of emancipation by legal or persuasive means. In the person of Brown they saw action at last. But they were not bloodthirsty. Brown was—or at least realistic. He knew—and he very probably was right—that blood must flow before slaves became free.

And another tantalizer: Why was the state of Virginia elected to try Brown? Mr. Oates explains: "Governor Wise then made a decision that was to bear significantly on the outcome of Brown's raid: although Brown had attacked and seized federal property . . . the governor decided to prosecute him in a Virginia court rather than turn him over to federal authorities." Federal prosecution would be too slow, Wise thought, and Brown, meanwhile, might be lynched. Moreover, Wise wanted to "enhance the prestige of Virginia at the expense of Washington, thus adding luster to his own political career among his fellow Southerners." Is it probable that President Buchanan, a nervous man and sensible of the anger in the North over Brown's ordeal, was happy to have Virginia take the rap?

There is another complexity: Brown was indicted not only for five murders at Harpers Ferry but for treason against Virginia. How could he have been treasonable to a state to which he owed no allegiance? He was born in Connecticut, and Virginia, prior to Appomattox, regarded herself as sovereign.

Such are sideline thoughts provoked by this powerful, scholarly book for which Mr. Oates deserves high praise. He has built Brown through overwhelming detail until all is clear—except Brown. Perhaps few know that Brown's hatred of slavery exploded early in life when he saw an ill-clothed slave boy beaten with a shovel. Or know of his tormenting early failures in land speculations, or of the tanning and wool business which carried him even to Europe into embittering fiascos. Very few may know of one Hugh Forbes, an English adventurer, whom Brown hired as grand strategist and expert in guerrilla warfare. This association ended in rows over Forbes' pay, leading the adventurer to expose Brown to authorities in Washington. The rascal even accused honest antislavery New Englanders of using Brown's hoped-for war to create a cotton panic and thus, in the know, to amass a pile of money. In all the somber story, Forbes gleams enchantingly—though one needs a twisted sense of humor.

Historians and general readers should praise Mr. Oates for so quietly telling all that is possible now to know of John Brown. And they may thank him, too, when they visit Harpers Ferry and upon the dark slant of its mountainsides feel his soul marching from morning light into red sunset.

—Scott Hart

Moon
Silvio A. Bedini, Wernher von Braun, and Fred L. Whipple
(Harry N. Abrams, Inc., $45)

Some poets worried that "their" moon would wane in the welter of statistics and space jargon we have heard since the quest to put a man's foot on the moon began. But that adventure gave rise to plenty of material for poets and also to this book with its own impressive statistics. It is written by three men intimately associated with lunar astronomy. (Silvio Bedini and Fred Whipple are associated with the Smithsonian.) It is 12 inches by 15¼ inches by 1½ inches. Its 267 pages contain 287 illustrations, 143 in full color. On a lunar coffee table it would weigh about 1.66 pounds; here it weighs ten. It begins 5,000 years ago and ends only yesterday with early scientific analyses of the Apollo 12 mission.

The publisher pulled out all the stops. The now familiar photographs have never looked better. And beyond the remarkable amount of information the book contains, lies plenty of material for poetic imaginations.

—James K. Page jr.

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Tours for Associates

Tours are planned exclusively for members of the Smithsonian Associates. For further information write: Smithsonian Reception Center, Great Hall, Smithsonian Building, Washington, D.C. 20560.

Foreign Study Tours

Many of the foreign tours previously announced are now filled to capacity and accepting waiting-list applications only. There is still limited space on the following tours:

East African Safari and Indian Ocean Cruise: A five-day visit to the great game preserves of Kenya and Tanzania, followed by a two-week cruise to Aldabra and others of the Seychelles. March 20 to April 15.

Roman Archaeology: An inexpensive tour for students, teachers and parents. Visits include Rome, Naples and 10 days in Sicily. July 6 to 30.

Russia: An unusual tour that includes Samarkand, Kiev, Vladimir and Novgorod. Second section will travel from October 25 to November 19.

Domestic Tours

Newly offered for Associates are these Domestic Tours:

Yankee Winter Weekend: Old Sturbridge Village in Massachusetts offers an opportunity to relive New England village life of the early 1800s. Craft demonstrations, folk music, sleigh rides. January 22 to 24.

Aransas National Wildlife Refuge and Padre Island National Seashore, Texas: A six-day visit to Aransas National Wildlife Refuge for observation of whooping cranes, shorebirds and land bird migrants. Visit includes Padre Island National Seashore, an 80-mile stretch of unspoiled barrier beach, the King Ranch and Welder Wildlife Foundation. February 21 to 26.

Smithsonian highlights

Arts and Industries Building

"The Hand of Man on America," a photographic documentary by David Plowden of the man-created objects that have helped to shape our country, is here prior to a two-year tour of the country (see article, page 26).

"Aerial Exploration" displays two aircraft used in exploratory ventures—the one the Lindberghs flew "North to the Orient" and the plane Lincoln Ellsworth flew across Antarctica.

In addition to the one-pound piece of Apollo 11 moon rock, an Early Bird Satellite—the operational backup model for the world's first commercial communications satellite—is here. A nuclear electric power generator, "SNAP 27," is a duplicate of the unit left on the moon.

"Creative Printmaking in Pakistan" features the results of a Smithsonian workshop in creative printmaking held in Pakistan in 1967.

Museum of History and Technology

"Do It the Hard Way: Rube Goldberg and Modern Times" is a special exhibition of cartoons, writings, sculpture and inventions, including a working picture-snapping machine (see article, SMITHSONIAN, November).

National Collection of Fine Arts

"American Impressionists" is a new gallery installation featuring the works of this group of artists.

"Paul Manship: Drawings and Sculptures" is a collection of 50 drawings and 15 small sculptures by this American artist (1885-1966).

National Portrait Gallery

"James Monroe," a life portrait of the fifth President of the United States, is an important new acquisition for the Gallery. It was painted by John Vanderlyn in 1816.

"John Muir (1838-1914)" is a teaching exhibition on the conservation movement in the U.S. at the turn of the century.

Division of Performing Arts

January 9: "Joanna Featherstone"—Afro-American poet.
January 22: "Paul Sanasardo Dance Company."
February 6: "Music From Marlboro"—chamber music.

(For further information on time and place of programs call 202-381-5407.)

Traveling Exhibition Service

Some of the more than 70 Smithsonian exhibits that will appear throughout the country during January are:

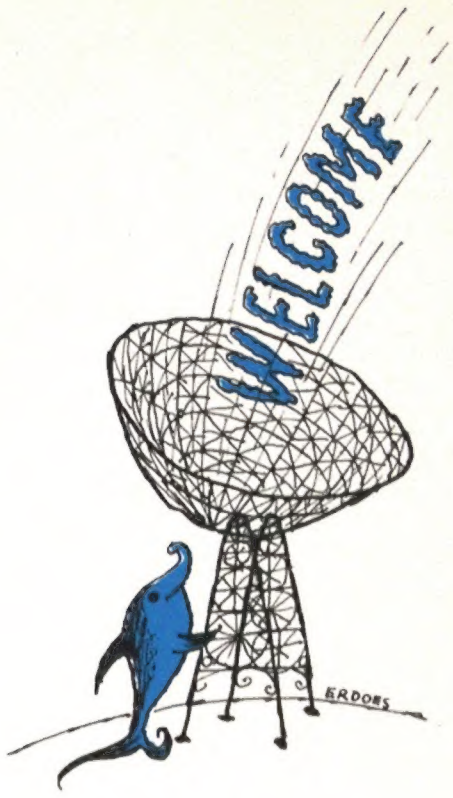
Scranton, Pennsylvania—"John Wesley Powell" (Everhart Museum of Natural History, Science and Art, opening January 2).
Seattle, Washington—"Vanishing Totem Poles of Alaska" (Pacific Science Center, through January 17).
Tempe, Arizona—"Urban Design: Manhattan" (Arizona State University, through January 24).
Montgomery, Alabama—"Mexican Folk Art" (Montgomery Museum of Fine Arts, opening January 2).

New Smithsonian Commons

New luncheon facilities are now open exclusively for staff, resident scholars and all members of the Smithsonian Associates. Located near the reception center in the original Smithsonian Building and open weekdays from 11:30 to 2:00 o'clock, the Commons offers a complete buffet luncheon for $2.00 upon presentation of a membership card.

By Patrick Ryan

To signals from cosmos, a choice of replies



Ever since thunder, the human race has been wondering if somebody out there in the wild black yonder might be trying to give us the big hello. Democritus presumed that there could be an infinite number of other worlds about the universe. Seventeenth-century Christiaan Huygens reasoned that other planets must have "rational creatures . . . and as diligent observers of the heavens as ourselves. . . ." Mathematician Karl Friedrich Gauss proposed in the 19th century that the Siberian steppes be planted with long lines of trees delineating the Pythagorean theorem so that watchers from other worlds might see that we were bright enough to know geometry— hopeful, perhaps, that the trees might evoke responsive cyclic quadrilaterals.

In the last decade or so, physicists Giuseppe Cocconi and Philip Morrison and radio astronomer Frank Drake have pioneered exploration of the 21-centimeter wavelength as a possible interplanetary channel, since it is the wavelength of radio waves emitted by the neutral hydrogen gas which pervades the galaxies of the cosmos.

And just this year, at the annual meeting of the International Astronomical Union in Britain, Dr. Antony Hewish of Cambridge University, who discovered the first pulsar, took matters a stage further by suggesting that if we did receive a signal to earth from an intelligent civilization, its receipt should initially be kept secret from mankind: "We should call a special meeting of the Royal Society and inform the politicians. Then the world would be told and a suitable reply to the aliens would be drafted."

It could possibly be helpful to this special meeting if we contemplated in advance just what might be this "suitable reply" to our first cosmic correspondents.

If the historic greeting is first received in Britain, the immediate problem would be whether etiquette permitted any reply to be sent to somebody to whom one has not been formally introduced. But when necessity overcomes punctilio, the probable British answer would be, "Can you lend us any money?" Should the signal fall on Russian ears, the cautious rejoinder from the Kremlin could likely be, "Before we go any further, comrades of the cosmos, would you please publicly confirm that we invented you." And were it picked up in the United States, that strange national hunger for international affection would perhaps compel the White House reply, "Distant friends, can you give us assurance that you truly love our great American people?"

Even if the world actually spoke as one, the time, just as the place, could influence the message. If the interplanetary inquiry, "Anybody in down there?" came in today, we might try their humor by riposting, "Twinkle, twinkle, little star, how I wonder what you are?" Or test their two-headed erudition and give them sidereal shivers with, MENE, MENE, TEKEL, UPHARSIN. If the great breakthrough comes in 50-years time, our answer might have to be, "Mayday, mayday, mayday. . . . Can you lend us any oxygen? We're knee-deep in pollution down here." A hundred years and it could desperately rise as, "Have you got any room for interplanetary immigrants? We're already standing two-deep on one another's shoulders."

A further half-century of scientific progress and all the intergalactic listeners may pick up is just the sound of a faint "Goodbye . . ." as the human race finally picks up its hat. And afterwards, nothing but the natural emission on a wavelength of 21 centimeters of the neutral hydrogen which pervades the galaxies of the universe. Until perhaps, one faraway evolutionary day, it will be broken by the first radio-whoop of the inheriting dolphins.

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